The City of
MAPLE VALLEY

LWPA

Draft
LAKE WILDERNESS INTEGRATED AQUATIC VEGETATION MANAGEMENT PLAN

NOVEMBER 2004

Lake Wilderness

Draft Integrated Aquatic Vegetation Management Plan

Lake Wilderness Lake Management District
Citizens Advisory Committee
City of Maple Valley
Lake Wilderness Preservation Association

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ACKNOWLEDGMENTS

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We would like to acknowledge Aquatechnex/Envirovision and King County Lake Stewardship Program as co-authors on the original Integrated Aquatic Vegetation Management Plan (IAVMP). This plan is an update of that effort and contains work from the original that is still pertinent.

This project was funded by the Lake Wilderness Lake Management District, which is administered by the City of Maple Valley. In kind services were provided by members of the Lake Wilderness Preservation Association and the LMD CAC.

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PROJECT OVERVIEW

Lake Wilderness is small lake (69 acres) located in southeast King County, within the City of Maple Valley. Total volume of the lake is approximately 1,300 acre-feet. The lake is relatively shallow with an average depth of 21 feet and a maximum depth of 38 feet. There are no permanent streams flowing into Lake Wilderness. Groundwater seeps, direct precipitation onto the lake surface, and stormwater runoff from the watershed are the only sources of incoming water. The surface water exits the lake along the northwest shore via Jenkins Creek. The lake has a very popular City park and a State Fish and Wildlife boat launch along the western shore. There is a five acre private park along the eastern shoreline owned by Lake Forest Estates. Additionally, King County maintains a trail, which runs along the eastern shoreline of the lake.

Presently the water quality in Lake Wilderness is characterized as good and it is rated as "mesotrophic" in terms of biological productivity and trophic state (King County 2003). However, the lake has had periodically high phosphorus levels possibly resulting from stormwater runoff (King County 1990). In January 1994 local residents formed the Lake Wilderness Preservation Association to preserve and protect the lakes' water quality and control aquatic plants. During an aquatic plant survey conducted by King County in the summer of 1994, the invasive aquatic plant Eurasian watermilfoil (*Myriophyllum spicatum*) was discovered for the first time in a few spots around the lake. In 1995 lake residents and King County Surface Water Management Division (King County 1996a) joined together to apply for a grant to develop a plan for long-term control of aquatic plants, including Eurasian watermilfoil. King County was awarded a grant for development of an Integrated Aquatic Vegetation Management Plan (IAVMP), which was published in 1997. A survey conducted as part of this planning effort found Eurasian watermilfoil to have spread rapidly in most shallow areas, either as a monoculture or intermixed with native aquatic plants.

During the summer of 1998, a whole lake Sonar (aquatic herbicide) treatment was performed to target the Eurasian watermilfoil. This treatment successfully removed this noxious weed from the lake (Aquatechnex, 2000). The native aquatic plant communities recovered rapidly from the impact of milfoil. By the summer of 2001, native aquatic plants had expanded to the point of impacting beneficial uses in some areas of the lake. Aquathol (aquatic herbicide) was applied that summer to reduce plant populations in portions of the lake (Aquatechnex, 2001).

In the fall of 2002, Eurasian watermilfoil plants were discovered growing from fragments in the waters adjacent to the public boat ramp. A fall survey found that this plant was also present at very low levels in the vicinity of the swimming beach at the City Park and in the southwest bay. These plants were treated twice with 2.4-D herbicide during the summer of 2003 and their populations were significantly reduced (Aquatechnex, 2002).

During the winter of 2002-2003 the City of Maple Valley contracted with Taylor and Associates to produce a "mid term" evaluation of the aquatic plant management program. One conclusion from the Taylor and Associates report is that the Integrated Aquatic Vegetation Management Plan (IAVMP) for Lake Wilderness should be updated (Taylor and Associates, 2002).

The updated plan provides a description of the aquatic plant control plan developed for Lake Wilderness. The basic recommendations selected for aquatic plant control in Lake Wilderness are:

- Continue to target Eurasian Milfoil with diver removal and the appropriate aquatic herbicides such as 2,4-D, Triclopyr and Fluridone
- Use Reward Aquatic Herbicide for long-term control of native submerged plants that interfere with beneficial uses.
- Continue to support the Lake Wilderness Citizens Advisory Committee (CAC) whose function is to make decisions annually about controls needed, and to review aquatic plant management goals.
- Establish conservancy zones for long-term protection of the aquatic habitat for fish and wildlife.

SUMMARY OF CHANGES IN 1997 IAVMP

This document is an update of the 1997 Lake Wilderness Integrated Aquatic Vegetation Management Plan (IAVMP) written by Envirovision and Aquatechnex, LLC for King County DNRP. There are a number of conditions that have changed both in the lake and with respect to management options since 1997. They are:

- The actions to manage Eurasian watermilfoil in the 1997 IAVMP were implemented. A whole lake Sonar treatment was performed in 1998 that effectively removed this noxious weed from the lake. Yearly diver surveys in 1999, 2000 and 2001 found no trace of milfoil in the lake (Allied Aquatics, 1998-1999; Aquatechnex, 2000-2002).
- In the fall of 2002, a few pioneering Eurasian watermilfoil plants were discovered near the public access ramp (Aquatechnex, 2002).
- There are a number of new herbicides available for use to target noxious and nuisance aquatic vegetation that were not available or considered in the 1997 plan.
- There have been a number of changes in the permitting systems used to manage noxious and nuisance aquatic weeds based on the US Ninth Circuit Court of Appeals decision in the Headwaters vs. Talent Irrigation District case issued in 2001.
- The problems facing the residents of the Lake Management District are different now than they were in 1997. There is a need to target and control the pioneering colonies of milfoil before they expand to the levels found in the lake in 1997. There are expanding impacts on beneficial uses caused by increasing levels of native aquatic plants; primarily elodea (*Elodea canadensis*).
- The Department of Ecology has updated the format and requirements for an IAVMP for nuisance aquatic weeds and algae, necessitating some changes.

The changes in the document reflect these conditions. There is an updated aquatic plant survey and use map. There are updates of the water quality information presented. There are updates in the discussion of management tools. There are

updates in the discussion of permit requirements. Also included are an updated problem statement, preferred management option and short/long term strategy.

PUBLIC INVOLVEMENT

Public Involvement for this project has included steering committee meetings, and public meetings. Each element is described below.

A Lake Wilderness Steering Committee was organized in July 1996 to guide the development of an IAVMP for Lake Wilderness.

In the development of the original plan, six meetings were held between July 1996 and April 1997. During this time the steering committee completed the problem statement, identified and developed management goals, organized the public meeting, selected aquatic plant control alternatives, and reviewed funding options.

A public meeting sponsored by the Lake Wilderness Steering Committee and the King County Surface Water Management Division was held on October 21, 1996. The purpose of the meeting was to provide background information about Lake Wilderness, present the problem statement and management goals drafted by the steering committee, and seek comments and questions from the public. A second public meeting was held in March 1997 to receive public comment on the draft plan. At the end of this process, the original IAMVP was completed, approved by the Washington State Department of Ecology, and adopted by the King County Council.

Since the original IAVMP was developed, the Lake Management District (LMD) was formed to fund operations on the lake. The City of Maple Valley as the administrator of the LMD passed Resolution No. R-02-220 creating a Lake Management District Citizens Advisory Committee (CAC) on May 13th, 2002. The CAC has been involved in the ongoing aquatic plant management activities on the lake from that time forward.

On June 2, 2003, the Lake Management District CAC presented a report to the Maple Valley City Council. This report provided a summary of a survey conducted by the LMD of the 382 residents or parcels within the District. Responses were received from 131 members, a response rate of 34 percent. Fifty-seven percent of survey respondents indicated an excellent or good satisfaction level with non-native plant (Eurasian watermilfoil) control activities. Regarding native plant control, only 46 percent of the survey respondents gave the district an excellent or good satisfaction level rating. Additionally, even with current plant levels lower than pre-treatment levels, only 41 percent of respondents felt that the current vegetation levels were acceptable, while 24 percent of respondents felt that levels were still too high and 34 percent indicated they were not able to evaluate the plant levels. (CAC, 2003).

These survey results suggest that even with the control measures conducted thus far to eradicate milfoil and reduce native plant levels, some residents still perceive the lake as having too many plants and many feel they don't not have enough information to make a judgment. The perception of too much vegetation may be difficult to change given the wide variation in what individuals see as acceptable. However, shifting this perception, as well as educating people who are uncertain, will be important in developing an

acceptable long term management program that protects other lake uses (such as fish habitat) associated with the presence of aquatic plants (CAC, 2003).

This report from the CAC proposed a number of action steps. One of the key recommendations was an update to the 1997 IAVMP. The CAC had a number of reasons for going through the process of updating this document. Since 1997, conditions in the lake have changed. The lake was dominated by Eurasian watermilfoil and the 1998 treatment removed that infestation. Native aquatic plants have increasingly affected beneficial uses identified by the community. There are a number of new tools available for aquatic plant management that were not available when the original plan was developed. There are new permitting requirements in Washington State for both noxious and nuisance aquatic plant management that require a current IAVMP. Lastly, Eurasian watermilfoil has been re-introduced to the lake.

The City of Maple Valley staff and the CAC assumed the role of the steering committee for the purpose of developing this updated IAVMP.

The Steering Committee identified the following interested parties:

- Lake Wilderness Preservation Association and residents of the Lake Wilderness LMD
- City of Maple Valley Public Works Department
- City of Maple Valley Parks Department
- King County DNRP Lake Stewardship Program
- King County Parks Department
- Washington Department of Fish and Wildlife (manages public access site)
- Washington Department of Ecology (plan and permit reviewer)

The first public meeting was held at the formative stage of plan development. This meeting was held on January 14, 2004. Mr. Bob White as the Public Works Director for the City of Maple Valley assumed the role of facilitator for communications and meetings. Mr. White also represented the interests of the City with respect to the Lake Wilderness Park and Beach. Sally Abella with King County Land and Water Resources Department was present as a consultant to the City and LMD. Don Harig with King County Parks Department represented the County as landowners adjacent to the lake. The CAC served as the steering committee. Members included Mary Anderson, David Barber, Andrew Gillespie, Steven Gleaves and Chris Richardson. A number of members of the public were also present.

A number of topics were covered during this meeting:

- A presentation was made that noted sections of the 1997 IAVMP that needed additional work to meet Ecology requirements
- The problem statement from the 1997 plan was presented for discussion and update
- A use map was created for Lake Wilderness based on input from the Steering Committee and members of the public that were present
- An overlay was created combining the Use Map and the Aquatic Vegetation Map from the summer 2003 survey. Areas where conflicts existed between aquatic vegetation and beneficial uses were identified and mapped.

- Aquatic plant management options for Eurasian watermilfoil and native aquatic plants were presented for discussion
- The steering committee discussed all of the options available and selected aquatic plant management tools that were appropriate for use under this plan

The information collected was summarized and used to develop a presentation for the public meeting on February 3, 2004.

The second public meeting was held on February 3, 2004 at the Lake Wilderness Lodge. City staff publicized this meeting. Notices were mailed to all residents within the LMD boundary and published in the local paper. Approximately 33 members of the community and interested resource agencies attended this meeting. Bob White from Maple Valley introduced the objectives for the meeting. These were to review the work of the Steering Committee and encourage comments and feed back on the work of the committee.

The presentations made at this meeting included:

- An introduction to the need for an IAVMP and the process
- The problem statement developed by the steering committee
- The use map and aquatic plant maps were presented along with the committee's recommended control and conservancy zones
- An overview of aquatic plant management tools
- The recommended aquatic plant management tools for this plan as established by the steering committee

There was excellent feedback from this group. Slight modifications were made in the use and control zone maps. There was consensus on the control options the steering committee had selected as appropriate.

The third public meeting was held on March 25, 2004 at the Lake Wilderness Lodge. City staff publicized this meeting. There were sixteen members from the community and interested resource agencies attending this meeting. Bill Guenzler and Diana Pistoll were present on behalf of the City of Maple Valley to review the work of the steering committee and encourage comments and feed back on the work of the committee.

The presentations at this meeting included:

- An overview of the IAVMP process and the work performed to date
- An overview of the preferred option selected by the public during previous meeting that was incorporated in the draft IAVMP
- A final request for comments or questions from the public prior to completing the final IAVMP

Again there was excellent feed back from this group. As the majority of these attendees had been to previous meetings, they were aware of the background and direction the plan was taking. There again was consensus that the control options the steering committee had selected were appropriate.

LAKE AND WATERSHED CHARACTERISTICS

Physical Characteristics

Lake Wilderness and its 318 acre watershed are located largely within the boundaries of the City of Maple Valley (Figure 1). The lake has a surface area of 69 acres and a total lake volume of 1,300 acre-feet. The lake is relatively shallow with a mean and maximum depth of 21 feet and 38 feet, respectively. Physical characteristics of the lake are summarized in Table 1.

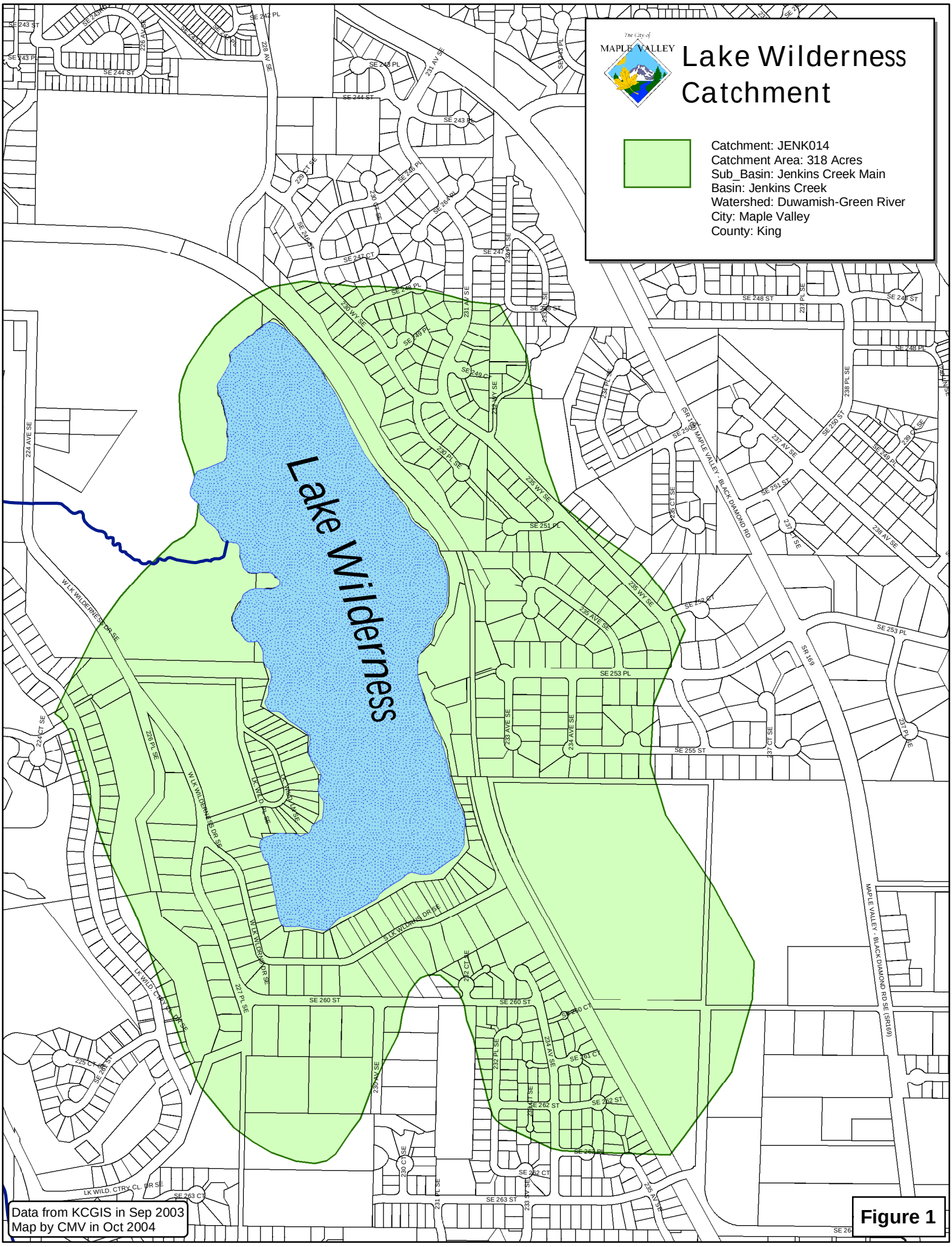
Table 1. Physical characteristics of Lake Wilderness and its watershed.

Characteristic	English Units	Metric Units
Watershed area	318 acres	128 hectares
Surface area	69 acres	27 hectares
Lake volume	1300 ac-ft	1.6 million cubic meters
Maximum depth	38 feet	11.6 meters
Mean depth	21 feet	6.4 meters
Shoreline length	9504 feet	2898 meters

Watershed soils are primarily Vashon-age recessional outwash, which are characterized by high (though variable) permeability and provide a direct hydraulic connection between surface water and the shallow aquifer (King County, 1990). Water enters Lake Wilderness via groundwater seeps, direct precipitation onto the lake, or stormwater runoff from the surrounding watershed. Lake Wilderness is the headwaters for Jenkins Creek. Water exits the lake along the western shore into Jenkins Creek (tributary #0087).

Jenkins Creek is one of the main tributaries of Big Soos Creek. Portions of Jenkins Creek serve a significant rearing function for anadromous fish and provide excellent overall habitat for resident fish. Jenkins Creek immediately downstream of the lake had been piped and was often pumped dry to irrigate the Lake Wilderness Golf Course (King County, 1997). Restoration projects for Jenkins Creek in the area of the lake outflow were recommended as part of the Soos Creek Basin Plan to stabilize and re-vegetate streambanks, improve instream habitat diversity, and redirect runoff through water-quality pretreatment facilities before discharge to the creek (King County, 1997). Channel improvements have been made which re-establish stream habitat and allow for fish passage (King County, 1994).

A popular 108 acre Lake Wilderness City Park is located along the northwest shore. In 1987, this was leased by University of Washington Center for Continuing Education, which was located at the north end of the lake, but was owned by King County. This facility passed to the City of Maple Valley in January 2002. The County still maintains a trail along the eastside of the lake which merges with the Cedar River Trail system. Presently, King County owns roughly one fifth of the shoreline and the City owns another third.


The City of
MAPLE VALLEY
Lake Wilderness Catchment
Catchment: JENK014
Catchment Area: 318 Acres
Sub_Basin: Jenkins Creek Main
Basin: Jenkins Creek
Watershed: Duwamish-Green River
City: Maple Valley
County: King
Lake Wilderness
SE 244 ST
SE 243 PL
SE 248 PL
SE 247 CT
SE 249 PL
SE 248 ST
SE 251 PL
SE 252 ST
SE 253 PL
SE 255 ST
SE 260 ST
SE 262 ST
SE 263 PL
SE 263 CT
SE 263 ST
224 AVE SE
228 AV SE
231 AV SE
234 AVE SE
236 AVE SE
238 AV SE
SR 169
MAPLE VALLEY - BLACK DIAMOND RD
MAPLE VALLEY - BLACK DIAMOND RD SE (SR169)
W LK WILDERNESS DR SE
S LK WILDRNS DR SE
LK WILD CTRY CL DR SE
Data from KCGIS in Sep 2003
Map by CMV in Oct 2004
Figure 1

The Lake Wilderness watershed is part of the Jenkins Creek Basin. Currently the majority of the 318 acre watershed is developed for residential use. Increases to the intensity of the land use can be expected in the project area in the future. As of August 2004 the land in the watershed is zoned Residential, Public Open Spaces, Multiple Use, and Business Park w/Conditions. Seventy-eight (78%) percent of the residential land in the watershed is developed, 2% of the multiple use land in the watershed is developed, and 64% of the land-zoned Business Park w/Conditions in the watershed is developed.

Public access is provided at numerous places along the shoreline, primarily through City owned property. There is a small boat launch managed by the Washington Department of Fish and Wildlife (WDFW) just south of the City Park.

Water Quality

"Eutrophication" is a term used to describe the physical, chemical, and biological changes associated with enrichment of a lake due to increases in nutrients and sediment over time. Although eutrophication can occur as a natural process that occurs slowly over time, it can be greatly accelerated by human activities in a watershed. Natural eutrophication processes occur on a time scale of hundreds to thousands of years and are generally not observable in a single human lifetime. Human induced or "cultural" eutrophication can result from activities within the watershed including development, forestry, resource extraction (i.e., peat mining) landscaping, gardening, and animal keeping. All of these activities contribute nutrients and sediment to surface waters. Sediment inputs from watershed activities results in the slow filling in of lakes, which also accelerates the overall eutrophication process. Cultural eutrophication can result in observable changes within a few decades, or less.

The most common way lakes are classified is by their trophic state, which defines a lake in relation to the degree of biological productivity. Lakes with low nutrients, low algae levels, and clear water are classified as nutrient poor or "oligotrophic". Lakes with high nutrients, high algae levels, and low water clarity are classified as nutrient rich or "eutrophic". "Mesotrophic" lakes have water quality characteristics between these two classifications.

Classifying a lake based on its trophic state is a useful way to describe changes in a lakes' water quality over time and assess the potential sensitivity of a specific lake to additional nutrient loading (Carlson, 1977). Total phosphorus, chlorophyll. and transparency are the three water quality parameters most often used to rate the overall trophic condition of a lake. Phosphorus is one of the essential nutrients for plant growth. Total phosphorus includes all soluble, organic, and particulate forms of phosphorus. Chlorophyll is one of a family of green pigments that allows green plants to perform photosynthesis. Chlorophyll concentration is a correlation with the abundance of algae in a lake. Water transparency is commonly measured as the depth at which a black-and-white disk (i.e., Secchi disk), when lowered into the water, ceases to be visible. Algal growth, organic acids, and suspended solids all influence Secchi depth transparency. Threshold values for trophic state are presented in Table 2.

Table 2. Trophic State Classification

Trophic State	Total Phosphorus (ug/l)	Chlorophyll (ug/l)	Transparency (meters)
Oligotropic	**<10**	**<4**	**>4**
Mesotrophic	**10-20**	**4-10**	**2-4**
Eutrophic	**>20**	**>10**	**<2**

Volunteer monitors have collected water quality data from Lake Wilderness since 1971. In 1971 - 1972, and 1974 - 1977, and 1982 - 1993, the former Municipality of Metropolitan Seattle (Metro) performed annual lake monitoring. (Metro 1989; King County Annual Reports, multiple dates). As of 1994, King County Surface Water Management (King County) and Metro became a single government. As of 1995 the lake volunteer monitoring program merged and was administered primarily by the King County Surface Water Management Division (which has now been reorganized into the Department of Natural Resources as the Water and Land Division beginning January 1997).

Historically, Lake Wilderness has been classified as being mesotrophic (Metro 1989; King County 2001). Mean seasonal (May through October) chlorophyll levels have generally fallen within the mesotrophic range and mean Secchi disk depths have often fallen in the oligotrophic range. However, mean total phosphorus concentrations have been consistently bordering on the mesotrophic - eutrophic threshold. The primary external source of these high phosphorus levels may be stormwater runoff (King County, 1990). Additional examination of water quality issues was beyond the scope of this project. The Lake Wilderness Preservation Association should continue their efforts of lake monitoring and stewardship actions to protect and address lake water quality.

Table 3. Water Quality Data for Lake Wilderness, 1994-2003 (Average May-October)

Year	Secchi (m)	Chlor-a (ug/l)	Total P (ug/l)
1994	3.9	4.24	26.5
1995	3.4	7.8	23.7
1996	4.9	4.41	23.5
1997	4.2	5.89	18.8
1998	5.4	2.52	17.9
1999	5.6	4.92	16.6
2000	5.6	4.01	16.6
2001	5.7	5.81	25.8
2002	5.8	4.68	16.2
2003	6.0	3.21	16.0

The most recent water quality data available for Lake Wilderness is presented in the King County Lake Monitoring Report, 2002 (King County, 2003). Phosphorus levels in 2002 had a mean that was lower than the data presented in the 1997 IAVMP. Chlorophyll a levels remained within the range presented in the 1997 IAVMP. Transparency levels were better in 2002 than those presented in the 1997 IAVMP.

Fish and wildlife community

The Washington Department of Fish and Wildlife (WDFW) has traditionally managed Lake Wilderness as a trout fishery. The lake has been chemically treated numerous times to remove competitive species. The last known treatments occurred in 1952, 1974, 1983 and 1988 to remove Pumpkinseed Sunfish (*Lepomis gibbosus*), Brown Bullhead Catfish (*Ictalurus melas*), Largemouth Bass (*Micropterus salmoides*) and Goldfish (*Carassius auratus*). Bass have since been illegally reintroduced and it is unknown if Sunfish, Bullheads, or Goldfish are currently present. (Pfeifer, R., 30 August 1996, personal communication).

The lake is stocked annually with approximately 14,000 Rainbow trout (Oncorhynchus mykiss). Some hatchery broodstock culls have been added in recent years to offer some larger early-season catch. Rainbow fry introductions have been terminated since competitive species have reduced their survival to near zero. Kokanee fry were stocked through 1995, but have also been discontinued due to poor survival.

Estimates of total Opening Day angler trips and catch on Lake Wilderness indicate that trout abundance has declined in the last decade (see Table 4). The decline is due in part to the presence of competitive species and severe predation by the double-crested cormorant. Presently the lake is to be managed by default as a mixed species lake (Pfeifer, R., 30 August 1996, personal communication).

Table 4. Opening Day Data for Lake Wilderness, King County 1997-2004, Interviewed Anglers

Year	Sampled Angler Trips	Sampled Catch	Sampled Catch/hour	Sampled Catch/angler
1997	24	48	0.39	2.00
1998	62	168	0.89	2.71
1999	29	109	1.12	3.76
2000	83	147	1.17	1.77
2001	122	451	2.47	3.70
2002	103	380	3.70	2.90
2003	138	468	3.39	2.28
2004	120	340	2.83	2.83

Aquatic Plant Community

Plant Survey

There were three surveys conducted on Lake Wilderness during the summer of 2003.

Two of these surveys focused on Eurasian watermilfoil. The first was conducted in June and this information was used to target the noxious weed for control. The second survey was performed in August and this information was used to evaluate control from the June treatment, locate any new plants and target remaining plants for control.

A detailed native aquatic plant survey was conducted as a baseline for measuring future work. The objective of this survey was to review the condition of the native plant community within the lake and to establish baseline information and procedures so that future surveys could be performed in a uniform fashion. Aquatechnex published and delivered a report to the City of Maple Valley in February of 2004 (Aquatechnex, 2004)

Representative samples of all aquatic macrophytes found during the aquatic plant surveys of Lake Wilderness were collected, pressed and mounted. These specimens are currently stored at the City of Maple Valley.

Plant Characterization

There were two mapping tasks undertaken during the summer of 2003. The first of these was focused on the detection of Eurasian Milfoil. The methods and results of this survey were presented in the two reports generated for the City by Aquatechnex (Aquatechnex, 2003). The second was the native aquatic plant survey and focused on developing a good understanding and establishment of a baseline for the native aquatic plants present in the lake.

Eurasian Milfoil

Figure 2 identifies those areas of the lake that exhibited Eurasian Milfoil growth during the June survey. The milfoil plants had expanded dramatically since the October 2002 survey mission. Areas where divers located one or few plants were marked with a Eurasian Milfoil point feature. Areas where divers found plants distributed throughout

Figure 2: Lake Wilderness June 2003 Eurasian Watermilfoil Survey

Surveyed Eurasian watermilfoil point
Surveyed Eurasian watermilfoil area

N
W E
S

AquaTechnex

700 0 700 Meters

are displayed as a Eurasian Milfoil area feature. The citizens Milfoil Patrol also found and mapped Eurasian Milfoil plants in this time frame. These areas were treated with AquaKleen (2,4-D) Aquatic Herbicide as reported to the City previously (Aquatechnex, 2003).

Figure 3 identifies those areas where the August milfoil survey detected plants. The AquaKleen treatment had drastically reduced the Eurasian Milfoil populations in the treatment areas, based on visual observation by Aquatechnex staff. A number of these plants were dead or dying stems. Others were stems that showed severe herbicide damage, but had small green shoots remaining. The area located near the City Park Beach was treated in late September using Dow DMA 4 IVM. Aquatechnex divers targeted the other areas where individual plants were found. A number of these plants were removed by hand pulling on the day of the survey. The remainder of these plants were removed the weekend of October 4, 2003

Native Aquatic Plants

Figure 4 is an overview map that documents the species and densities of native aquatic plants found in Lake Wilderness. The determination of the species present was performed by a combination of diver collection, rake collection at the sampling points present, and boat observation. The most common species of native aquatic plants discovered and collected in the lake were:

- *Elodea Canadensis (predominant)*
- *Potamogeton zosteriformis*
- *Potamogeton pusillus*
- *Najas flexilis*
- *Potamogeton richardsonii*
- *Chara sp.*

There may be other species present at very low levels that were not detected because they did not occur on a transect, rake sample or were not visible from the boat.

The dominant species present in Lake Wilderness in August of 2003 was *Elodea canadensis*. This species was recorded at 75 of the 80 sampling points evaluated for this survey. This plant formed extremely dense mats that reached the lake surface from depths of over 10 feet in many locations. Elodea was particularly dense along the west shoreline of the lake.

The second most prevalent species present in Lake Wilderness was *Potamogeton zosteriformis*. This species was found at 43 of 80 points sampled throughout the lake as shown on Figure 4. *P. zosteriformis* was commonly mixed with the Elodea beds from the four foot contour to the deep water end of the littoral zone.

The macro algae chara was found at 17 of 80 sampling points in the lake as shown on Figure 4. It generally occurred as an understory in the Elodea beds. Chara was also found in the shallow areas (1-2 feet) and at the deep water edge of the littoral zone.

Potamogeton pusillus and *Najas flexilis* were generally found growing together in the shallows along the western shoreline and in the shallows of the bay on the southwest portion of the lake. These species were sampled at 12 of 80 sampling locations.

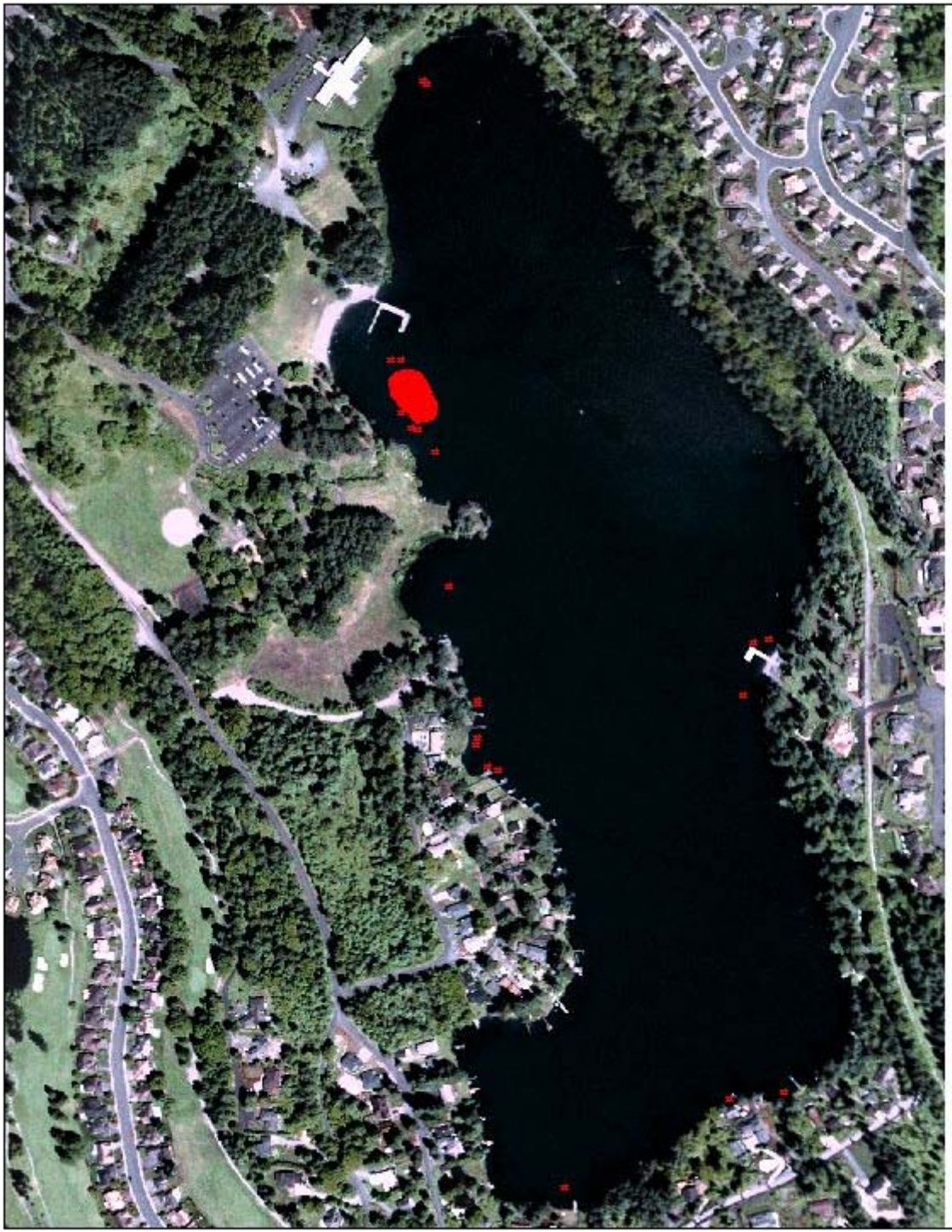


Figure 3:
Lake Wilderness
August 2003
Eurasian Milfoil Survey

Surveyed sample points with Eurasian
Surveyed area of Eurasian watermilfoil

N
W E
S

AquaTechnex

200 0 200 Meters

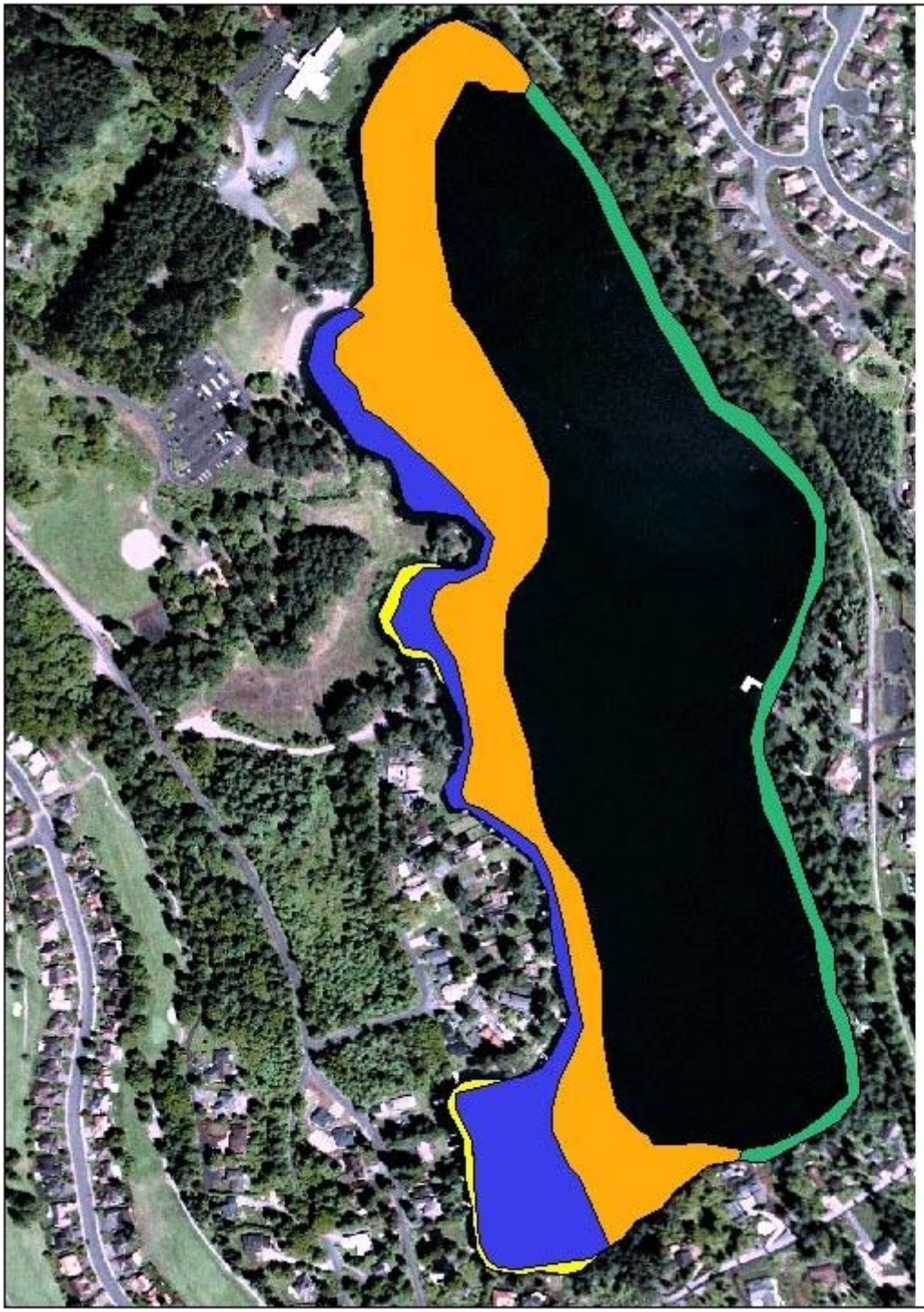


Figure 4:
Lake Wilderness
August 2003 Survey

- Moderate Submerged Plants (E. canadensis, N. flexilis, P. pusillus)
- Dense Submerged Plants (E. canadensis, P. zosterformis)
- Sparse Submerged Plants (E. canadensis, P. zosterformis)
- Sparse Submerged Plants (N. flexilis, P. pusillus, E. canadensis, Chara spp.)

N
W E
S

AquaTechnex

200 0 200 Meters

Potamogeton richardsonii was present but rarely recorded during this survey. This plant was found growing in one small area of the lake in the vicinity of the City Park Beach. The plant was found at 2 of 80 sampling points.

- The Orange polygon present on Figure 4 shows the areas of the lake that were dominated by elodea with *P. zosteriformis* mixed within the beds. The area of this polygon is 17.5 acres. In many locations the dense Elodea meadows reach the surface and may interfere with beneficial uses.
- The Blue polygon present on Figure 4 shows the areas of the lake that again were dominated by Elodea, but also had *P. zosteriformis*, *P. pusillus* and *Najas flexilis* mixed in. The *P. pusillus* and *Najas flexilis* occurred generally along the shoreline in the 1 to 3 foot depths of the lake. The area of this polygon is 6.6 acres.
- The green polygons present on Figure 4 show areas of the lake that were very sparsely populated with aquatic plants. Elodea was the dominant species present in this area and there were occasional potamogeton species present. This shoreline drops off rapidly so the littoral area is very narrow. This shoreline is dominated with timber and the littoral area is shaded from sunlight for much of the day. It is possible that these two factors have an impact on the ability of this section of the lake to support dense aquatic plant communities. The area of this polygon is 3.6 acres.
- The yellow polygons present on Figure 4 show areas of the lake that are very sparse populated with *Najas flexis*, *P. zosteriformis*, *P. pusillus* and Chara. The area of this polygon is 0.9 acres.

In summary, Lake Wilderness is 69 surface acres in area. Of that, 28.6 acres have native aquatic plant species present with 24.1 acres exhibiting moderate to dense growth of these species. The remaining acres of the lake are deep water habitat where light limits aquatic plant growth.

Previous aquatic plant surveys were conducted in 1976, 1978, 1989, and 1994 by King County Staff (King County 1996). In 1976, *Potamogeton pusillus* and *Elodea canadensis* were noted as the dominant plants in the lake. In 1980, *Potamogeton pusillus*, *Elodea canadensis*, and *Najas flexilis* were the dominant species. Eurasian watermilfoil was not found in the lake until the 1994 survey. At that time, Eurasian watermilfoil dominated much of the submergent plant community, particularly around the north end of the lake and around the swimming beach, then maintained by King County Parks Department.

The steep slopes, residential development, and high use areas which characterize the shore of Lake Wilderness has limited wetland plant communities around the lake. Several areas support stands of cattails, but other wetland and emergent plant species are scarce.

Beneficial Uses

During development of this plan the steering committee was asked to develop a list of beneficial uses the lake provides and identify where those uses occur. Beneficial uses identified included; swimming, boating, fishing, hiking, wildlife viewing, and fish and wildlife habitat. WDFW manages a boat launch just south of the City Park. It should be

noted that boating includes electric motors but internal combustion engines are no longer allowed on the lake. The City Park includes a heavily utilized recreation area. The County maintains a 3.9 mile trail system along the eastern shore which merges with the Cedar River Trail to the north. The extensive trail system allows for hiking, wildlife viewing, and limited access to the lake. Public swimming is concentrated near the designated swim area at the City Park. On the east shore, a 5 acre private community park also provides a swimming beach. The point of land south of the City Park that juts out from the western shoreline is another popular swimming area. Swimming also occurs near private property but these areas have been impacted by dense plant growth. Wildlife that frequent the lake include hawks, bald eagles, otters, heron, and cormorants. Table 5 is an inventory of wildlife observed using the lake by area residents.

Table 5. Inventory of Wildlife Observed Using Lake Wilderness

Otters (6)	**Osprey (2)**	**Eagle (3)**
Muskrat (2+)	**Frogs**	**Crawfish**
Freshwater Clams	**Snails**	**Leeches**
Raccoons	**Squirrels**	**Opossum**
Blue Heron	**Elk herd (on path)**	**Deer**
Coyote (on path)	**Bats**	**Canadian Geese**
Starlings	**Woodpeckers**	**Owls**
Sea Gulls	**Cormorant**	**Trumpeter Swan**
Kingfisher	**Common Loon**	**Wood Duck**
Mallard Duck	**Blue Wing Teal**	**Gadwall Duck**
American Widgeon	**Ring-neck Duck**	**Red Head Duck**
Canvas Back Duck	**Lesser Scaup**	**Greater Scaup**
Common Goldeneye	**Bufflehead**	**Hooded Merganser**
Common Merganser	**Plover Shore Bird**	**Water Skippers**
Dragonfly	**Water Snakes**	**Trout**
Catfish	**Sunfish**	**Bass**
Turtles		

The CAC developed a Use Map for Lake Wilderness (Figure 5) that shows where different beneficial uses generally occur in the lake. This map was presented at two public meetings for additional comment. Four different use zones were developed by the CAC and members of the public that attended these meetings. The first zone was classified as public swimming area. This use occurs at two locations within the lake, one at the City Park Beach and the other at the Lake Forest Estates Private Beach (limited to members of that community). This zone is 3.1 acres in size and is classified as having a “High Intensity of Control”. The second zone was classified as public shoreline fishing/boat launch. This area is located at the state public access site and along the point north of the access within the City Park. This zone is 1.9 acres in size and is classified as having a “High Intensity of Control”. The third zone was classified as shoreline swimming/boating. This zone is located in front of private property south of the public access, around the south side of the lake and up the east side of the lake to the end of the homes. This zone is 6.7 acres in size and is classified as having a “High Intensity of Control”. The remaining areas of the lake were classified as conservancy zones and are classified as “No Control” areas.

Figure 5: Lake Wilderness Use Areas

Shoreline swimming and boating area
Park swim areas
Fishing and boat launch area
Conservancy area

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The total acreage in the high use areas is 11.7 acres. There are 28.6 acres of the lake that support submerged aquatic plants. These high use areas comprise 38.7 percent of the acres with aquatic plant life present.

PAST PLANT MANAGEMENT EFFORTS

In the time frame since the publication of the 1997 Lake Wilderness IAVMP, there have been a number of aquatic plant management activities implemented.

In 1998, a whole lake Sonar treatment was performed to target Eurasian watermilfoil. This herbicide has proven to be extremely effective on this noxious weed. Sonar® is a systemic herbicide which means it is effectively absorbed by plants and translocated by both roots and shoots. It then inhibits carotenoid synthesis, killing the plant. Effects of Sonar® treatment become noticeable within 7 to 10 days of application, with complete control often requiring 60 to 90 days. Four treatments were performed in June and July of that year. Milfoil needs to be exposed to Sonar at rates of 8-10 parts per billion for a time period of six to eight weeks. The treatment scenario in 1998 used an initial treatment to dose the lake and three following treatments to maintain the required parts per billion. Diver surveys during that year confirmed excellent control of the noxious weed.

During the summers of 1999, 2000, 2001 and early in 2002 contracted divers found no evidence of Eurasian watermilfoil and aquatic plant management activities outlined in the original plan were not necessary (Allied Aquatics, 1999; Aquatechnex. 2000-2002). The community did however feel that native aquatic plants (primarily elodea) were expanding to problematic levels in some high use areas of the lake in 2001. The original IAVMP prescribed treatment with Aquathol aquatic herbicide when this threshold was reached. A treatment with Aquathol was performed in the summer of 2001 focusing on the high use shoreline swimming areas south of the public boat access around to the southeast corner of the lake.

During the summer of 2002 surveys showed that noxious or native aquatic plants posed little threat to beneficial uses of the lake during the growing season and no treatment activities took place. In September of that year, a few milfoil plants were discovered near the public access. These were most likely introduced at that site, milfoil is commonly spread by fragments on boat trailers. A diver survey found additional new plants north of the public access in the swimming beach area and in the southwest bay. Some of these plants were removed by divers and it was determined that treatment should be instigated early the following summer.

In 2003, three aquatic plant management activities took place.

During the winter and spring, the City of Maple Valley contracted with Taylor and Associates to conduct a “mid term evaluation” of the 1997 IAVMP and the other activities of the LMD. The objective was to determine if conditions had changed and if the LMD was meeting the needs of the community. This study took place throughout the spring and summer months. The Taylor report recommended that aquatic plant survey and mapping methods be standardized so that results could be comparable from year to year (Taylor Associations, 2003). They also recommended the update of the 1997 IAVMP.

There was a significant effort to control the Eurasian watermilfoil present in the lake during 2003. An early summer survey was performed to identify the current locations of the plant. Treatment areas were defined and treatments were performed with 2,4-D (AquaKleen) to target this plant (Aquatechnex, 2003). A second survey was performed in late summer and remaining plants were mapped. A few plants occurred at scattered locations around the lake and were removed by divers. A small 1.5 acre plot was treated with 2,4-D (Dow DMA 4 IVM) in the bay near the City swimming beach.

A comprehensive aquatic plant survey was also conducted during the summer of 2003. The results of this survey have been incorporated into this document and the entire report is available from the City of Maple Valley or Aquatechnex (Aquatechnex, 2003)

PROBLEM STATEMENT FOR LAKE WILDERNESS

Problem Statement for Lake Wilderness:

Members of the CAC and the community made the following points concerning changes in the lake since the publication of the first problem statement in the 1997 IAVMP (King County 1997) and implementation of the first plan:

- Lake Wilderness is much improved since 1997, when the milfoil infestation was making serious inroads on the beneficial uses of the lake, and the 1997 IAVMP was produced as a tool to combat the problem.

- Milfoil has been essentially extinguished by the control actions taken after the Plan was approved, but vigilant monitoring will be necessary to make sure it does not become re-established in the future. Annual professional surveys are important, in addition to the monthly volunteer surveys, which have been organized and conducted by the Lake Wilderness Preservation Association. This combined surveillance program was put in place after the finding by lake stewards of floating milfoil fragments in the summer of 2002. Both types of surveys may be necessary far into the future.

- Other noxious weeds such as yellow flag iris are becoming a problem, and their numbers may need to be addressed in the future.

- Some native plants have the potential to create safety and recreational problems, such as pondweed (Potamogeton spp) and *Elodea canadensis,* which have increased greatly since milfoil removal. Even before milfoil became a problem, some native plants were obstructing recreational uses. The extent of elodea and other native plants must also be monitored closely and kept in check by quick action to make sure that they do not replace milfoil as a major issue for the lake.

- The swimming areas, which posed safety hazards when milfoil was prevalent, have been restored and are used extensively by area residents. Boating and fishing are also much easier to pursue, without losing gear or becoming entangled in the mats of milfoil vegetation. The lake is once again beautiful and inviting. More people are using the lake recreationally than during the period just before milfoil control was accomplished.

Figure 7, Eurasian Milfoil in Lake Wilderness, 1998 Pre and Post Treatment

This image shows conditions on Lake Wilderness in June of 1998. The dominant weed species is Eurasian Milfoil. This infestation severely impacted Beneficial Uses

This image shows post treatment condistions in August of 1998. The original IAVMP recommended a whole lake Sonar herbicide treatment to target this noxious weed. The treatment removed the Eurasian Milfoil from the lake. The lake remained free of milfoil until late 2002. PIoneering colonies of the weed were discovered and have been treated to prevent expansion back to June 1998 levels.

- The city and community need to work closely with Washington Department of Fish and Wildlife concerning problems and management of the lake involving issues of fisheries and the public boat launch.

- Property values are no longer adversely affected by deteriorating conditions. Many people living on the lake are using best management practices and are educating new homeowners when possible on how to take care of their lakefront property without endangering lake health. However, education is an on-going process and the informal efforts going on now will likely need some support in the future in order to reach everyone who has an impact on the lake.

This list of comments was compared to the first problem statement published in the 1997 IAVMP to produce a new statement for the updated plan. The current statement follows.

Problem Statement 2004:

Before the implementation began of the 1997 IAVMP in 1998, Lake Wilderness had a severe infestation of Eurasian milfoil that impacted most beneficial uses of the lake, including swimming, fishing, hiking, bird-watching, boating, family gatherings, and events, as well as quiet enjoyment of the surroundings. Important habitat for wildlife was adversely affected by the invasive nature of the plant. Property values were at risk, and there were fears of degrading water quality if the situation persisted. Since the lake has long been a focus for fun, relaxation, and renewal by the community, the situation was considered to be very serious. Citizens came together with government to craft an IAVMP that outlined the program they would follow in combating milfoil, as well as other nuisance aquatic plant problems.

Lake Wilderness has benefited greatly from the success of the milfoil control that occurred with implementation of the first version of the IAVMP. The lake is once more a delightful place to relax, linger along the shoreline, or play. Property values have increased and the recreational benefits of the lake have been restored. The water quality of the lake is good and appears stable at present. The popular park, now belonging to the city of Maple Valley, has large numbers of visitors, and the public boat launch managed by WDFW is also heavily used.

The intent of the community surrounding Lake Wilderness is to keep the lake healthy, accessible, beautiful, and a safe place to enjoy aquatic activities. In order to accomplish these goals, the current plan is to retain significant portions of the shoreline and shallow water zones as conservancy areas, while managing aquatic plants in areas of high use to support the recreational activities enjoyed at lake.

Because of the high level of public use, there may always be a danger of milfoil re-infestation or introduction of other noxious weeds. A small milfoil population was found in 2002, which may have been a re-introduction. This suggests that Lake Wilderness will always be at risk, and ongoing surveillance will be necessary far into the future, as well as the ability to move quickly to eradicate new populations of noxious weeds if detected. In addition, some native plants such elodea, have been found to grow rapidly in the areas vacated by milfoil and could create similar problems on a smaller scale if left unchecked. In the future they could need additional control in order to retain the beneficial uses of the lake and a healthy diversity of habitat for wildlife.

AQUATIC PLANT MANAGEMENT GOALS

The final step before beginning development of a plant control plan was to define goals against which the plan could be evaluated. Setting project goals is an important step because they are used to determine what control strategies will work, and will ultimately be used to evaluate whether plan implementation has been a success. The following list of management goals for Lake Wilderness was developed by the CAC. A group rating process was used to rank the priority goals for plant control. The process resulted in the following priority goals.

- Develop a long-term plan for controlling plants in high use areas and protecting water quality.
- Remove all invasive noxious aquatic weeds
- Control nuisance native plants in high use areas to recover open water for swimming, boating and fishing.
- Develop a diverse and healthy balance of native plant communities and maintain them at a level in the conservancy areas that support lakeside resident needs as well as benefits fish and wildlife.
- Develop an educational program that promotes lake and watershed stewardship and provides a greater awareness of the continual threat of noxious weeds and the importance of homeowner Best Management Practices (BMPs) for the long-term protection of Lake Wilderness.

AQUATIC PLANT MANAGEMENT OPTIONS

RCW 17.15.010 defines Integrated Pest Management for the State of Washington as:

"a coordinated decision-making and action process that uses the most appropriate pest control methods and strategy in an environmentally and economically sound manner to meet agency programmatic pest management objectives. The elements of integrated pest management include:

(a) Preventing pest problems;

(b) Monitoring for the presence of pests and pest damage;

(c) Establishing the density of the pest population, that may be set at zero, that can be tolerated or correlated with a damage level sufficient to warrant treatment of the problem based on health, public safety, economic, or aesthetic thresholds;

(d) Treating pest problems to reduce populations below those levels established by damage thresholds using strategies that may include biological, cultural, mechanical, and chemical control methods and that must consider human health, ecological impact, feasibility, and cost-effectiveness; and

(e) Evaluating the effects and efficacy of pest treatments."

There are two areas of concern associated with the aquatic plant community in Lake Wilderness: Eurasian watermilfoil eradication, and the long-term control of native plants. All control alternatives described and approved by Ecology (2003) were considered for use in Lake Wilderness. These included the use of various herbicides, mechanical removal or harvesting, sediment dredging, stocking Grass Carp, and other techniques. Appendix A provides information on the most feasible methods that were presented to the steering committee as possible strategies. The process for selection of the preferred control option(s) began with presenting to the steering committee the entire range of control alternatives available and describing the advantages and disadvantages of each and how each might best be utilized on Lake Wilderness. The next step was then to combine these control alternatives to form different strategies that met some or all aquatic plant management goals. Five control strategies were presented to the Lake Wilderness steering committee for consideration in selecting a recommended action plan. These scenarios involved the following combination of techniques:

1. Diver survey combined with hand removal and/or treatment with systemic herbicides to target Eurasian watermilfoil in the lake
2. Aquatic Plant Harvesting to target problem native aquatic plant growth in high use areas
3. The use of contact herbicides such as Reward combined with hand removal for control of native submerged weed growth
4. Stocking of the lake with Grass Carp for long-term control of both Eurasian watermilfoil and submerged native plants
5. A whole-lake Sonar® treatment for the eradication of Eurasian watermilfoil, followed by the stocking of the lake with Grass Carp for the long-term control of native plants.

The first strategy (Diver survey combined with hand removal and/or treatment with systemic herbicide) was eventually selected by the CAC for the management of Eurasian watermilfoil. The King County Regional Eurasian Milfoil Control Plan indicates that this is a recommended option for targeting pioneering colonies of this plant (King County, 2003)

The third strategy listed (the use of contact herbicides such as Reward combined with hand removal) was eventually selected by the steering committee as the preferred strategy for native submerged plants impacting high use areas.
Initially there was some concern expressed about the use of chemicals in an aquatic environment. Discussions of the toxicity of the selected herbicides and the herbicide approval process helped to alleviate some of these concerns. The following summary of the herbicide approval process is provided for clarification.

To be approved for use in aquatic environments, a herbicide must pass stringent toxicity testing by the federal government. These tests are designed to assess impacts to the target population (plants) as well as non-target populations such as fish, aquatic insects, and other organisms. The tests also examine what happens to the chemical over the long term to insure the chemical quickly breaks down into a non-toxic form and that, for example, it does not accumulate in sediments or fish tissue. Washington State has in turn set even more stringent standards. The Department of Ecology has developed Risk Assessments for the aquatic herbicides allowed for use in the state and completed a

Programmatic Environmental Impact Statement to support their safe use (Ecology 2003). There are use restrictions for each which are described in the following sections.

These two options meet the test of managing the pest in a cost effective manner with minimal to no ecological impact.

Aquatic plant harvesting was considered at length. It was rejected because of the cost and ecological impact. Aquatic plant harvesting systems are not cost effective in Lake Wilderness, based on the number of acres identified that might need attention. Harvesting also has direct ecological impacts on the aquatic environment. The King County Regional Milfoil Control Plan recommends against deploying harvesting systems in lakes with early infestations of Eurasian Milfoil (King County, 2002).

When Eurasian watermilfoil is present, harvesting operations can speed up the re-colonization of the littoral area. This weed grows back much faster than native plants and tends to dominate. Milfoil also spreads by fragmentation and the harvesters do not capture all of the plant material. There can be a significant impact on the fish and invertebrate life in the lake from harvesting operations.
Wisconsin DNR scientists documented this impact on Halverson Lake where they found that harvesting 18 acres of aquatic plants removed 33,000 fish and 3 million invertebrates in a summer (Engel, 1990).

Grass carp were also considered. This option was rejected because of the ecological impact and economic considerations. The King County Regional Eurasian Milfoil Control Plan recommends against stocking grass carp to control this noxious weed (King County, 2002). There is a substantial conservancy area identified in this plan where it is not appropriate to target and control native aquatic plants. Grass carp roam the lake once introduced. They would have the same impact on plants in the conservancy areas as they would in the high use areas. In order to obtain the necessary level of control in the high use areas, fish would have to be stocked at a level that would impact the plants lake-wide. The economics of screening the outlet and the statutory need for a lake restoration study to obtain a permit were limiting factors as well.

Appendix A contains an analysis of aquatic plant management alternatives, their effectiveness, environmental impacts, human health risks and costs. The steering committee and public selected the proposed tools from this list.

RECOMMENDED AQUATIC PLANT CONTROL PLAN

Immediate Control Strategy (Watermilfoil Eradication)

At the end of 2003, Eurasian watermilfoil had been effectively removed where it occurred in Lake Wilderness. It will be critical to maintain an ongoing program of detection and control in the coming years.

There should be two diver surveys of the lake performed during the summer in the future with the specific objective of locating, mapping and controlling any Eurasian watermilfoil plants present in the system. The divers should be supported by a mapping vessel equipped to record the location with sub-meter precision for relocating infestations. One survey in June should be performed to find any plants present early in the growing

season. A second survey in August should be performed to detect and map any plants emerging from fragment that may not have been visible during the early survey. Surveys of the locations should be reported back to the City and the CAC.

The Lake Wilderness Preservation Association has a citizen's milfoil patrol that also surveys the lake systematically on a regular basis. This is a critical component of this survey process because it adds to the probability of finding plants early and it keeps the citizens involved in the management of this invasive species.

At the conclusion of each of these survey missions, maps should be generated and presented to the CAC with recommendations for control. The recommendations for control should be implemented shortly after the survey to insure control and to limit the spread of the plants found. In areas where few plants are present, diver hand removal is appropriate.

If plants are spread throughout a area or region of the lake, systemic herbicides should be applied to target them. There are two selective systemic herbicides available for use in Washington State for the control of Eurasian watermilfoil.

The first of these is 2,4-D (AquaKleen Granular and Dow DMA 4 IVM). The use of this product may be impacted by the recent federal court ruling in the Washington Toxics Coalition (WTC) vs. Environmental Protection Agency case. In this case, the WTC argued that the EPA failed to consult with NOAA (the agency charged with protecting and recovering endangered salmon) as required under the Endangered Species Act. WTC listed 55 active ingredients EPA had failed to consult on and one of these is 2,4-D. WTC won this case because the required consultation had not taken place. The judge ruled that EPA must determine if the active ingredients on this list may impact salmon or will not impact salmon. In cases where EPA has not completed this work or where they have ruled that the product might impact salmon, the judge has imposed buffer zones that prohibit the application of these products. At the time of this writing, 2,4-D remains on the list of products EPA has not finished making a determination on. There are exceptions in the order for the application of aquatic labeled 2,4-D for the control of plants on the noxious weed list. In the short term, the Department of Ecology has determined that the Judge's order does exempt the use of 2,4-D from buffer requirements and this product can be used in salmon bearing waters for the control of state listed noxious aquatic weeds like Eurasian Milfoil. Over the life of this plan, this situation is bound to change. The EPA will make a determination regarding this product at some point. The City and CAC should keep abreast of this situation.

Triclopyr (Renovate) is the second systemic herbicide that is selective for Eurasian watermilfoil. This product has been cleared in the WTC case by EPA. EPA has determined that its use will not impact endangered salmon.

A decision regarding the product to apply should be made just before treatment. At the time of this writing, the WTC case is in the process of being considered by various regulatory agencies. Renovate may be the better choice in the short term because it has received EPA clearance. 2,4-D may also have received this clearance prior to the start of the treatment season.

The application of aquatic herbicides to target noxious aquatic weeds requires coverage under the state's NPDES permit for that activity. The applicator must obtain this coverage and follow the direction in that permit as part of the application process.

Aquatic Herbicide Use Considerations

Both 2,4-D and Triclopyr are systemic herbicide which means it is effectively absorbed by plants and translocated by both roots and shoots. Effects of each treatment become noticeable within 7 to 10 days of application, with complete control often requiring 14 to 21 days. Both herbicides are considered to have very low toxicity to humans and aquatic organisms at applied rates and come with no EPA swimming or fishing use restrictions. As both of these products are herbicides, they do come with irrigation restrictions. 2,4-D treatments restrict water use for irrigation until an approved assay indicates that levels in the treatment area have dropped to 70 ppb. Triclopyr treatments restrict water use for irrigation until an approved assay shows the levels are below detection. This normally occurs in the timeframe of one week. WA DOE requires a 24 hour swimming restriction for Triclopyr treated waters and a 24 hour swimming advisory when 2,4-D is applied.

Immediate Control Strategy (Nuisance Aquatic Plants)

Elodea canadensis is currently impacting beneficial uses in the high use areas defined in this plan (Figure 6). A early summer survey should be performed to document the continued impact within those areas. A Reward (diquat) aquatic herbicide treatment should be performed in June after the survey to target these plants within the high use zones identified by this plan.

The application of Reward to treat nuisance aquatic weeds requires coverage under the state's nuisance aquatic weed and algae NPDES issued by the Department of Ecology. This general permit provides direction that must be followed by the applicator. This permit can be issued for multiple years (until the NPDES permit expires or is renewed) once this IAVMP is approved by WA DOE. There is a $300.00 per year permit fee charged by Ecology.

Aquatic Herbicide Use Considerations

Reward (diquat) is a contact herbicide. It is used to maintain nuisance levels of aquatic plants within defined treatment areas. It must be applied evenly across the area of concern. There is little or no effect on plants outside the treatment area. There are no swimming or fishing restrictions placed on treated water when using Reward by the US EPA. WA DOE does however require a notice indicating a 24-hour swimming advisory. There is a 72-hour irrigation restriction because this product is a herbicide.

Long-Term Plant Control Strategy

The establishment of conservancy zones and a combination of bottom barriers and Reward® was selected for long-term management of submerged nuisance aquatic plants in Lake Wilderness. In general, approximately 16.9 acres (61.3 percent of the littoral area) of aquatic plants will be preserved as conservancy area, an estimated 0.2 acres may utilize bottom barriers and 11.7 acres of high use areas will be targeted as needed annually with Reward. This plan will meet and exceed the target reservation of 25 percent of the vegetated areas for fisheries and wildlife. It must be clarified that the map and area estimates are provided to designate the approximate control zones only.

Figure 6: Lake Wilderness Aquatic Plant Management Area Map

Legend

Plant management areas

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Within the herbicide treatment zone, the area targeted for actual plant control would be determined each year based on the need to reduce plants.

Conservancy Zone Designation

The designation as Conservancy Zone applies to how native plants are treated over the long term. As a conservancy zone, this portion of the lake would be left in its natural state and aquatic plants would be left to provide important fish and wildlife habitat. There are two possible future changes to the conservancy zone. A site just north of the existing City Parks swimming beach, and a site south of the community swimming beach established on the eastern shoreline, have been identified as potential future swimming beaches. If these are developed as swimming areas, some aquatic plant control would be allowed. There are no costs associated with establishment of conservancy zones.

Bottom Barrier Use

Bottom barrier may be selected for use by individual residents who desire long term control in their beach and swimming areas. Bottom barriers are manufactured sheets of material that are anchored to the lake bottom to prevent plants from growing; similar to weed barriers commonly used in lawn and garden activities. Several bottom covering materials have been used with varying degrees of success. A woven polyester material such as Texel® is one of the most effective bottom barriers because it is durable and it provides efficient exchange of gas produced from decaying organic matter (roots and other debris). It is typically installed in the winter by unrolling the 15 foot wide sections to the specified length and anchoring them with sand bags spaced 10 feet apart. Bottom barriers should be maintained on an annual basis to ensure adequate coverage and anchoring. Re-installation may be necessary to control encroachment of plants in areas adjacent to dense growth.

Bottom barriers are effective in deep as well as shallow water and do not have special requirements that eliminate their use in different areas. Control intensity and duration varies depending upon sediment accumulation and encroachment from adjacent area. If properly installed and maintained, bottom barriers can provide a high level of control for five years or more. The primary advantage of bottom barriers is the intense level of control and the ability to be very selective about the control area. The main disadvantage is the high cost per unit area controlled and the necessary maintenance to keep them effective over time. In addition, WDFW requires that bottom barriers be removed after two years unless a decomposable material is used (i.e. Burlap).

Annual Aquatic Plant Control

The last part of the long-term plan consists of using the herbicide Reward to provide annual control of plants. The application area for Reward® will vary from year to year depending on survey results, for example in 2004 11.7 acres of submerged plants were present in the high use control area. Application of the Reward® should be scheduled to achieve the greatest control (to maximize the amount of biomass treated and minimize the period for re-growth) while minimizing the impact on lake use. A mid- to late June application date should be targeted.

Reward® Use Considerations

Reward is a contact herbicide. It is used to control nuisance levels of aquatic plants within defined treatment areas. It must be applied evenly across the area of concern.

There is little or no effect on plants outside the treatment area. There are no swimming or fishing restrictions placed on treated water when using Reward by the US EPA. WA DOE does however require a notice indicating a 24-hour swimming restriction. There is a 72-hour irrigation restriction because this product is a herbicide. There are no timing restrictions for Reward treatments on Lake Wilderness.

Invasive Plant Prevention and Detection Program

The use of herbicide treatments, hand pulling and surveys in Lake Wilderness will effectively eliminate Eurasian watermilfoil from the lake for the time being. However, this plant could return to the lake from the introduction of Eurasian watermilfoil fragments. Other non-native, highly invasive plants of concern which are not currently found in the lake include; Parrotfeather (*Myriophyllum aquaticum*), Brazilian Elodea (*Egeria densa*), Hydrilla (*Hydrilla verticillata*), Fanwort (*Cabomba caroliniana*), and Water Hyacinth (*Eichhorinia crassipes*). The focus of control efforts for non-native plants is a prevention and detection program. A contingency plan is also presented in case control of a large area is required.

To be effective this program should include both a strategy for preventing infestation and a detection program. The objective of source control is to prevent non-native submerged plants entering the lake. In addition to the threats posed by Eurasian watermilfoil and Brazilian Elodea, two now common non-native submerged plants, there is the more serious threat associated with the discovery of hydrilla in nearby Lakes Lucerne and Pipe.

The public boat launch represents an area where there is a high potential for introduction or re-introduction of invasive plants. The addition of a boat and trailer wash facility is sometimes recommended to enhance plant fragment removal. However, these can be expensive to install since they require a water supply (well and pump), drainage facilities and possibly a holding tank to keep the wash water and associated pollutants (plant fragments, heavy metals, oils, etc.) from entering the lake or stream, and they require continual oversight and maintenance. Such an effort could be coordinated with WDFW, which currently manages the boat launch. Furthermore, it is difficult to regulate their use and therefore their effectiveness is questionable. At a minimum, existing signage at the boat launch warning about milfoil and exotic plant introductions should be enhanced with specific instructions on how to clean boats and trailers.

Lake residents should also receive informative brochures on an annual basis reminding them of plant invasion problems and the importance of keeping their own equipment free of plants. It is also recommended that the lake community institute some public information campaign for opening day of the fishing season and a few other key weekends. Simply having volunteers hand out exotic plant identification cards for a few hours and help with boat and trailer checks will emphasize the importance of the effort and remind boaters of their responsibility to check equipment.

Early detection is an important step to protect against new infestations. While an infestation is still relatively small there are options for control that are much less expensive than the whole lake treatment methods required at this point. Early detection if done properly requires both a trained group of lake volunteers who are responsible for occasional patrol of the lake, as well as semi-annual diver surveys to assess the plant community. The main purpose of these surveys is to search for Eurasian watermilfoil and any other exotic plants. However, it will also provide a means for monitoring the

native submerged plant community and determining where future control efforts should be focused. Volunteers would be trained each year in plant identification and survey techniques and each would be given the responsibility for surveying a certain section of shoreline every other month during the growing season. Their purpose would be to note any substantial changes in the plant community and to look for new invasions of nuisance species. Professional divers would perform a more complete survey every three to five years to assess all plants.

The primary advantage of controlling small infestations is that it reduces the chance that a large area would need to be controlled by a more intensive and expensive technique. A drawback of controlling small infestations are the high costs associated with diver surveys and hand pulling. A professional diver survey of the entire plant habitat would take approximately 1 day and cost approximately $2,000. (Costs for hand pulling by contract divers range from $500 to $2,400 per day depending upon plant type, acreage, and density.) Although the volunteer survey program should have no long-term cost, a training workshop would be necessary.

Some diver surveys and herbicide treatments are contingency elements to the overall aquatic plant control plan for the lake. These costs would only accrue in the event of another infestation by Eurasian watermilfoil or another exotic plant. For species other than milfoil the costs could possibly be covered through an “early infestation grant” by the Department of Ecology.

Citizens Advisory Committee

This body of work will fall to the Lake Wilderness Citizen Advisory Committee that was created in May 2002. The committee is comprised of area residents, City staff and a representative from King County Department of Natural Resources and Parks. The Citizen Advisory Committee has the following responsibilities:

- Represent the residents of the LMD to the City Council
- Propose an annual work program consistent with Ordinance No. 0-98-57 and the 1997 Lake Wilderness Integrated Aquatic Plant Management Plan (or its successors)
- Provide input and suggestions to the City regarding the implementation of the district’s annual work program
- Work with the City in the preparation of any educational materials related to Lake Wilderness and the LMD
- Each November review and provide input to the City on the preparation of an annual report to Maple Valley City Council, City Manager, and the Lake Wilderness Preservation Association regarding progress on the LMD work program and health of the lake.
- Support a public meeting to brief LMD members on the contents of the annual report and related LMD activities.

PUBLIC EDUCATION PROGRAM

The public education program for Lake Wilderness consists of three parts; the exotic plant prevention plan, previously described lakeside stewardship education, and watershed protection/pollution prevention for protecting the lakes’ water quality.

Exotic Plant Prevention

All watershed residents should be sent copies of an exotic plant prevention brochure. A group of lake homeowners should be trained to identify Eurasian watermilfoil and other invasive plants and perform periodic volunteer surveys of the lakeshore. The exotic plant prevention plan was described in detail in the Invasive Plant Prevention and Detection Program section.

Lakeside Stewardship Education

Each lakeside resident should be educated about how to reduce the amount of pollutants entering the lake from their property, as well as about things they should do to help retain a complex, diverse, and therefore healthier lake environment. The properties located directly adjacent to the lake have the greatest potential for adversely impacting the lake since pollutants generated on these properties have direct access to the water and no other defined surface inflows exist.

Lakeside property owners should be provided with information about problems associated with typical urban type landscapes around lake shorelines. This should include information on the drawbacks of using ornamental turf (lawns), and the benefits of adding shoreline plants and diversified lawn plantings which create habitat structure for birds and wildlife.

Some important considerations for proper stewardship of lakeside property are described here. Informative brochures or newsletter articles should be used to educate lakeside property owners about best management practices (BMPs). Some examples of stewardship ideas include:

- Limit turf and landscaped areas to no closer than 25 feet from the shoreline. Native plants and grasses should be considered for landscaped areas to decrease the amount of fertilizers, pesticides, and other pollutants used.
- Establish a “pollutant free zone” within 50 feet of the shoreline. Try to keep all pollutants; gas for boats, painting projects, landscape fertilizers and poisons, and etc. away from this zone.
- Plant a shoreline buffer of shrubs and tall grasses, preferably native species. This one small activity will cause multiple environmental benefits. If properly designed it will keep geese and other waterfowl from moving onto lawn areas. The vegetation will help filter out pollutants from landscaped areas before they reach the lake. It will provide protection from shoreline erosion, and it will provide habitat for the many wildlife species that utilize nearshore areas.
- Preserve natural “structure” that exists along the shoreline and in the shallow nearshore area, or if necessary, clean up only a narrow strip alongside the dock area. If a tree along the shoreline finally falls in, leave it. Add structure in the form of tree tops, twig bundles, and rocks to diversify and naturalize the nearshore area and attract more fish and wildlife.
- Allow emergent vegetation, and other plants to colonize some portion of waterfront area.

The current LMD is not authorized to fund water quality education, however public education and involvement can be centered on the annual aquatic plant survey. Public education and involvement can also center on the annual plant survey. In the spring of each year the CAC should plan a short workshop to describe plant survey results from the past year and the plant control strategy for that year (e.g. where and when Aquathol® will be applied). During the workshop, a schedule should be agreed upon for volunteer surveys. At this time everyone should be trained or re-trained on plant identification and survey techniques.

King County Water and Land Resource Division's Lake Stewardship Program is a resource for technical assistance and noxious week identification training within unincorporated King County and within contract cities. The program also offers speakers on lake-related topics and can tailor programs to the community needs. The Lake Wilderness community, in the City of Maple Valley, could continue to participate in the program for specific contracted services.

Watershed Protection/Pollution Prevention

Over the long term, the quality of Lake Wilderness may be most impacted by development activity in the watershed. Recommendation of watershed protection measures is beyond the scope of this plan; however lake residents should be aware of the potential impacts and take a pro-active role to insure protection of their lake. Lake residents need to monitor watershed related activities to insure that appropriate best management practices (BMP's) are being carried out in nearby commercial and residential developments. This should include; tracking where activities are occurring, reviewing permit applications to insure proper BMP's have been included, reporting violations to permit conditions or water quality standards, and generally keeping informed about the watershed problems.

The current LMD is not authorized to fund Watershed prevention/pollution prevention programs.

PLAN ELEMENTS, COSTS, AND FUNDING

The original IAVMP suggested a number of funding options to cover projected plan costs for a 10 year period to fund the plan's implementation. In 1998, the citizens around the lake voted to establish a Lake Management District (LMD) for this purpose. The funds and activities are specified at the time of voting.

Lake Management Districts

A lake management district (LMD) is a locally defined special assessment used to raise revenue to implement lake protection or improvement activities. Property owners on or near a lake pay a special charge on their property, either annually or on a one-time basis. LMD's have been formed and operated successfully in King, Snohomish, Skagit, Stevens and Thurston counties.

Section 36.61 of the Revised Code of Washington (RCW) describes the process for LMD formation. According to the law, an LMD can be initiated through a petition to the City or County Council by property owners of at least 15 percent of the acreage within the proposed LMD boundary or by the Council who can adopt a resolution of intention. The petition or resolution of intention needs to include the following information: (1)

proposed lake protection or improvement activities; (2) total amount of money to be raised; (3) whether money will be collected annually or one-time only; (4) amount of assessment (one-time or annual); (5) duration of LMD; and (6) proposed LMD boundaries.

After the petition is adopted or the resolution of intention is passed, a public notice is sent and a public hearing is held. This is followed by a special election in which each property owner has one vote for every dollar of proposed assessment. The proposed LMD must be approved by a simple majority of the votes cast. If there is a positive vote, the Council adopts an ordinance to create the LMD. If there are no appeals, the Assessor prepares a special assessment roll which lists each property and the proposed special assessment. There is a second public hearing at which individuals can raise objections to the amount of the special assessment. The Council may revise the special assessment roll in response. Then the special assessment roll is confirmed and billing can proceed. The money is administered by the City or County but a community-based advisory board can be appointed by the Council to oversee the project expenditures.

This process was completed in 1998 for Lake Wilderness and the Lake Wilderness LMD was established for the calendar years 1998 through 2006.

Current Funding Scenario

King County provided a grant of $46,631.00 to fund control activities in 1998. Special assessments totaling $226,977.00 were to be collected over the life of the LMD. The LMD stopped collecting the assessments in 2001 (no assessments in 2002, 2003 and 2004) because tax revenues were exceeding the expected expenditures of the district. Lake Management Districts are established for a set time period, they sunset at that point and the citizens can choose to establish a new district if necessary. One of the problems faced by the Lake Wilderness LMD is that any funds remaining un-spent at the end of the LMD has to be refunded to the tax payers of the district. On December 31, 2003, the fund balance was $54,485.00.

The following table details the maximum possible cost to the district for proposed activities. An additional assessment may be necessary to meet the obligations.

TABLE 6: CURRENT FUNDING SCENARIO

Activity/Year	2004	2005	2006	total
Milfoil Control	$650.40	$4,000	$4,000	$8650.40
Native Plant Control	$3,428.	$3,500.	$3,500.	$10,428.00
Loosestrife Control	$1,000.	$1,000.	$1,000.	$3,000.
Spring milfoil Survey	$1463.40	$990	$990	$3443.40
Fall milfoil Survey	$990	$990	$990	$2,970.
Native Plant Survey			$6,000	$6,000.
Plan Update	$11550.			$11,550.
Technical Support King County	$4,000	$4,000	$4,000	$12,000
Permit Fees And Consultant Coordination	$319.	$550	$550	$1,419.
Staff Support	$14,369.	$5,600.	$5,600.	$25,569.
TOTAL	$37,769.80	$20,630.	$26,630.	$85,029.80

At the conclusion of the current LMD, all options for funding new activities will have to be explored. At that time, both control activities and funding sources will be identified

IMPLEMENTATION AND EVALUATION

The following is a detailed step-by-step approach to implementation of this plan:

Step 1) Set up a Plan Implementation Committee

This step is completed; this is the current CAC. The lake community will control how and whether the plan is implemented. Many of the tasks this committee will need to carry out are described in the plan under the “plant control advisory committee” section. The Citizens Advisory Committee established by the City of Maple Valley will serve in this role.

Step 2) Secure a Funding Source

This step was taken through the passage of the LMD IN 1998. Funding is secure through the life of the LMD set to sunset after December 31, 2006. The citizens and the City should consider renewing the LMD or other funding options, at that time based on the situation.

Step 3) Conduct yearly surveys for Eurasian Milfoil and Nuisance Weeds

There are two Eurasian watermilfoil surveys to be conducted each year. The first milfoil survey will be completed early in the summer to determine the need for control efforts and will include observations of the native plant community. The reports generated and provided to the LMD, will outline proposed control operations based on actual conditions in the lake. The LMD will then direct operations as necessary.

Step 4) Apply aquatic herbicides or perform diver operations as proposed

In each of the next two years, surveys will determine the levels of noxious and nuisance weeds and recommend control activities. A licensed applicator and/or sponsoring entity should obtain permit coverage to perform any necessary aquatic herbicides depending on the determination of the surveys. The appropriate herbicide (AquaKleen, Dow DMA 4 IVM or Renovate for Eurasian Milfoil; Reward for excessive native plants in high use areas) should be applied as determined by the surveys. If milfoil levels are lower and the recommendation is to perform diver removal operations, a professional dive team should perform those tasks.

Step 5) Continue a Public Education Plan

The King County Lake Stewardship Program staff has provided excellent resources to distribute to the community. This relationship should be maintained as that agency has considerable expertise in this area. An annual meeting should be performed prior to control operations on the lake to update the citizens and provide them an opportunity to have questions answered. New residents will be moving into the district and they will not have the benefit of participating in this and prior public processes. Solicit professionals to volunteer to make presentations to the community and set up dates for presentations. Also develop an article for the quarterly newsletter describing different lake protection issues.

Step 6) Institute a Long-Term Plant Monitoring Program

Continue the Milfoil Patrol instituted in 2003 by the LWPA. Contact professional aquatic plant experts for conducting bi-annual surveys. A detailed plan for monitoring and reporting is found in the 2003 Aquatic Plant Survey (Aquatechnex, 2004). Those protocols should be followed in future aquatic plant mapping efforts and the 2003 survey should be used as the baseline to compare and evaluate results.

Step 7) Conduct Annual Evaluation/Implement Monitoring Plan

The CAC will complete a written annual evaluation that describes what elements of the plan have been implemented, relates the existing plant community to established goals, and makes recommendations for the next years activities.

SUMMARY AND CONCLUSIONS

Nuisance aquatic weed infestations in Lake Wilderness have increased since the successful removal of Eurasian watermilfoil in 1998,characterized by elodea and Potamogeton sp. Without some sort of action plan the aerial coverage of the plant is likely to increase and further impede recreational use of the lake. Eurasian watermilfoil has been re-introduced to the lake and requires search and suppression operations to insure it does not once again claim this lake. This plan deals with eradicating Eurasian watermilfoil with the use of systemic herbicides coupled with diver operations and selective herbicide use (Reward®) for the long-term control of submersed plants..

Re-invasion by Eurasian watermilfoil or other non-native plants will be closely monitored through annual diver surveys. A contingency plan is included in case invasions do occur. Public education and awareness programs will focus on the prevention of exotic plant introductions.

Lake residents will be involved in development of the yearly plant control strategy and will be responsible for soliciting volunteers for surveys and plant control activities. This will insure long-term involvement of lake residents in lake management decisions and activities.

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Appendix A

Aquatic plant control alternatives, their effectiveness, environmental impacts, human health risks and costs

No Action

There are both short and long term impacts associated with not controlling aquatic plants in Lake Wilderness. Eurasian watermilfoil has been re-introduced to the lake. Without implementation of the control options presented in this plan, this weed will expand to the levels present in the lake prior to 1998. The original IAVMP documented the impacts this level of infestation had on Lake Wilderness and were the basis for the formation of the lake management district to implement that plan (King County, 1997). The economic impact of no action is extreme. The original whole lake Sonar treatment cost approximately $100,000.00 (Allied Aquatics, 1998). Allowing this noxious weed to re-colonize the lake would necessitate a similar expenditure to solve the problem in future years. The original IAVMP also identified the impacts of excessive levels of native aquatic plants in designated high use areas of the lake. These include impacting the aesthetic and real estate values of adjacent properties, posing a safety threat to the swimmers in the lake, restricting the areas of the lake where fishing can occur and degraded water quality (King County, 1998).
The "no action" alternative was discussed with the Steering Committee and presented to the public. This option was not considered appropriate for Lake Wilderness and will not considered as a reasonable aquatic plant management strategy.

Environmental Manipulations

Currently Available Techniques - Preventive. The preventative techniques which may have utility in Lake Wilderness's submersed plant control efforts focus on control of inputs of the growth nutrient phosphorus. This element has the greatest potential to be controlled and thus control (limit) algal growth. These techniques include both structural and non-structural (Best Management Practice) options.

- **Watershed Controls**: These include limiting the introduction of phosphorus to the watershed.

Advantages of Watershed controls (in general):

-reduce nutrient loading at their sources,
-provides shade and lowers stream temperatures
-reduces streambank erosion and sedimentation in lake,
-provide benefits over wider area than the lake.

Disadvantages of Watershed controls (in general):

-may require changes in land use
-may require construction or modification of facilities, purchasing of property and hiring of maintenance personnel,
-may require regulatory support and personnel

Costs of Watershed Controls:

-vary greatly (not determined)

Appropriateness for Lake Wilderness:

-Watershed controls are appropriate for water quality protection at Lake Wilderness but would not be expected to affect the growth of Milfoil in either the short or long term. The LMD is not allowed to fund watershed control efforts.

- **Public Awareness and Involvement Program**: The understanding and involvement of lake and watershed residents will be necessary if the process of nutrient, algae and aquatic plant growth controls is to succeed. Therefore a public education and awareness program is strongly recommended. Such a program would focus on and promote lake stewardship but would also keep the lake "community" informed about measures that are to be, and have been, performed in and around the lake. Especially important will be evaluation of control program effectiveness and program "adjustments" over time. Through newsletters, public meetings, exhibits at fairs and local media coverage (to name a few) information on the lake should be disseminated and opportunities given for reply from the community.

Some subjects which can interest lake residents and users are: simplified algae and aquatic weed information, sources of, and solutions to, nutrient enrichment, shoreline stabilization and re-vegetation, options for lawn fertilizer use, pet waste management, non-phosphate detergent use, and discouraging bird and waterfowl feeding. Training to teach plant identification can be very pertinent as well.

Whenever possible, the lake community should be directly included in information collection and synthesis as part of the public involvement program. This can include the presence of citizen representatives on monitoring (data collection) trips performed by consultant technicians.

Advantages of a Public Awareness and Involvement Program:

-provides education and public awareness,
-provides opportunity to gather consensus and public support,
-provides opportunity to involve the lake residents and users in the process.

Disadvantages of a Public Awareness and Involvement Program

-requires committed organization to implement and provide continuity.

Costs of a Public Education and Awareness Program:

-$2,000 to $8,000 per year.

Appropriateness for Lake Wilderness:

-An ongoing Public Awareness and Involvement Program is very appropriate for Lake Wilderness.

Currently Available Techniques - Physical Control. These techniques include manual or mechanical efforts that can remove, cover, shade or dry out all or part of problem plant growth.

- **Hand Removal**: Removal of submerged vegetation by hand digging or pulling is an intensive but generally small scale management option. This method involves removing

the entire plant (leaves, stems and roots) by hand or with a hand-held gardening tool, collecting the plant materials in a storage bag for transport and disposal on shore. In water depth greater than about three feet, the use of SCUBA divers is typically needed in order to effectively manage a location.

The effectiveness of plant removal depends on sediment type, visibility (water clarity), plant type, and thoroughness in removing the entire plant. Based upon these variables, the level of plant control will may from one month to multi-year management.

Advantages of Hand Removal:

-immediate clearing of the water column,
-highly selective technique, in that individual plants are removed,
-can be implemented in sensitive area where disruption must be kept to a minimum,
-effective in aggressive control of sparse or small infestations in the lake, around docks or in swim areas.

Disadvantages of Hand Removal:

-technique is time consuming and labor intensive,
-visibility may become obscured by the disturbance of sediments during harvesting thus delaying plant removal,
-management can be costly in deeper water, especially when divers are used
-control may only be short-term or seasonal; based on location and surrounding infestations.

Costs of Hand Removal:

-no cost if performed by volunteers,
-$800 - $1,600 per day for two divers and a support boat & operator,
-typical coverage from 400 to 2,000 square feet per day.

Appropriateness for Lake Wilderness:

-Hand removal of Milfoil is appropriate for Lake Wilderness considering the current level (and distribution) of the infestation and the stated lake management goals. Therefore, hand removal is included in the IAVMP.

- **Bottom Barrier Installation**: Bottom barriers are highly effective in the small to moderate scale control of aquatic vegetation. The barriers are typically synthetic (geo-textile) fabrics, or burlap, but a variety of other materials have been used including sand-gravel, polyethylene, polypropylene, synthetic rubber, fiberglass screens and nylon film. These materials cover the lake sediments and existing plants and prevent further growth. By covering the lake bottom that the plants emerge from, all plants are effectively prevented from growing in those areas. Washington State typically allows the use of burlap when covering native plant areas and burlap or synthetic material when covering noxious weed areas. These barriers are typically 100% effective in the installed areas initially and installation can be conducted at any depth with the assistance of divers and a support vessel. Bottom conditions do not typically impede most barrier installations, but logs and debris are typically cleared from the area. Duration of control is dependent upon type of material used, application techniques, sediment deposition and permit (WDFW Hydraulic Project approval) requirements.

Since gases are produced in the sediments under the barrier, the barrier must be attached or weighted to the bottom and allow these gasses to pass through it. Over time, these barriers can lose effectiveness if sediment builds up on them, providing a substrate for plants to root. Yearly maintenance by a dive team can prolong the effectiveness of this technique indefinitely (except with burlap which will decompose and must be replaced to maintain effectiveness).

Bottom barriers are expensive when used on a large scale. In addition, there can be environmental impacts if large areas of a lake bottom are covered with these materials. Bottom barriers are most applicable for individual properties and are recommended for around docks. Bottom barriers may not work well in swimming areas when placed over soft sediments, however. If swimmers walk on them, they tend to push the mats into the sediment.

Advantages of Bottom Barriers:

-no toxic chemicals are placed in the water,
-provides immediate removal of nuisance plant conditions upon placement,
-easily applied to small, confined areas around docks, moorage's or beaches,
-they are hidden from view (in deeper waters),
-effective in isolated management practices, especially in Milfoil control
-some materials are reusable.

Disadvantages of Bottom Barriers:

-potentially high material cost for synthetic products,
-labor intensive and high costs for utilizing divers,
-limited durability of certain materials,
-not species specific,
-potential permit restrictions on location of barrier (spawning areas), type of material, type of plants attempting to control and length of time barrier will be allowed in place,
-gas accumulation under barrier can cause barrier to be lifted hindering boat passage or swimmers,
-periodic maintenance needed to remove sediment build up and secure placement,
-may need to be removed after two years to allow native vegetation to re-establish. WDFW requires removal after two years unless a decomposable material is used (i.e. Burlap)

Costs of Bottom Barriers:

-$0.35 to $0.85 per square foot for materials (burlap or geo-textile),
-$0.35 to $0.60 per square foot for labor to place barriers,
-$0.30 to $0.50 per square foot for labor to remove barrier.

Appropriateness for Lake Wilderness:

-Bottom barriers are not considered appropriate for use at Lake Wilderness by the CAC.

Water level draw-downs

Water level draw-downs are not appropriate for Lake Wilderness because lake levels can not be manipulated to the point where drawdown would impact aquatic plant growth.

Mechanical Control Methods

- **Hand Cutting**: This technique involves cutting of plants below the water surface, but roots are not generally removed. Tools used in cutting include scythes, thin cables, rakes or other specialized devices that can be pulled through the weed beds by boat or from shore. One popular device consists of two single-sided stainless steel blades forming a "V" shape which are connected to a four foot handle and tied to a rope.

Advantages of Hand Cutting:

-immediate removal of nuisance submerged plant growth,
-costs are minimal,
-can be performed throughout the season as needed.

Disadvantages of Hand Cutting:

-labor intensive and time consuming,
-generally not species specific
-visibility may become impaired by turbidity generated by cutting,
-short-term plant control as the root system is not removed; cutting is typically needed multiple times each season,
-may be difficult to contain and remove plant fragments.

Costs of Hand Cutting:

-cutting devices range from $50 to $800
-no labor cost if performed by volunteers,

Appropriateness for Lake Wilderness:

-Hand cutting is considered inappropriate for Lake Wilderness by the CAC, because of the difficulty in insuring that milfoil is not present.

- **Mechanical Harvesting**: An extension of the hand cutting discussed above involves the use of larger equipment that can cut or mow aquatic plants below the water surface. Barge mounted weed cutters, for instance, will cut the stems of submerged vegetation over large areas, with that vegetation typically floating off or being collected by the operator with some other implement. Aquatic weed harvesters are an improved version of a large weed cutter. These systems cut, collect and transport the vegetation for disposal on shore. A typical weed harvesting system will consist of the harvester and a shore station for unloading the harvested vegetation into a transport system for disposal.

Aquatic harvesters have a number of cutting blades located on the harvesting head and a conveyor system behind the knives that collects the plants and deposits them on a barge. There is typically a storage conveyor system that the plants fall onto when cut that facilitates unloading the machine at the shore station. The shore station equipment

is usually either a shore conveyor that mates to the harvester and lifts the cut plants into a dump truck or other transport system, or a trailer conveyor that performs the same function as well as transports the harvester from lake to lake. Harvesting systems normally cut the plants from five to seven feet below the surface and can harvest up to two acres per day depending on the distances to off-loading sites.

Aquatic plant harvesters work well at cutting the plants and removing the bulk of the plant material from the lake. They do allow some plant fragments to escape, however, and they do not necessarily inhibit the continued growth of the cut plants. Harvesting is also not species specific (unless used in single species dominated areas) aquatic plant harvesters remove significant amounts of young fish and invertebrates during harvesting operations. Harvesters should not be used on lakes that are infested with Milfoil in the pioneering or early colonization stages since additional fragments will accelerate the spread of the plant.

Advantages of Mechanical Harvesting:

-no toxic chemicals added to lake,
-immediate removal of plants and contained nutrients,
-limited interference with use of the water body,
-minimal bottom disturbance,
-reduction in sediment accumulation by removing organic matter which normally decays and adds to the bottom sediments
-harvested plants can be used as compost.

Disadvantages of Mechanical Harvesting:

-slow process (two acres per day under ideal operating conditions), dependent on
-availability of off-loading sites,
-labor and equipment intensive; must involve cutting and collection of plant material,
-typically requires repeat cutting for full season control,
-creates plant fragments which have potential to spread and establish in other portions of the lake (especially a concern with exotic species),
-non-selective and can be detrimental to non-target plants and animals
-high capital costs for machine purchase or use by management consultant

Costs of Mechanical Harvesting:

-$600 to $900 per acre for contract commercial aquatic plant harvesters,
-$100,000 to $180,000 for harvester/off-loader purchase,
-cost of disposal not determined.

Appropriateness for Lake Wilderness:

-Mechanical harvesting is not considered appropriate for Lake Wilderness because of the need for regular, repeat cuttings, the difficulty in cutting effectively in the rocky shoreline areas, the impacts on the aquatic ecosystem (fish and invertebrate removal) and the cost.

- **Rotovation**: Rotovation, or underwater cultivation, is a newer concept in mechanical aquatic plant management. It can provide for longer term control of some aquatic plants (than with harvesting) and it can remove plants to greater depths than conventional harvesters (approximately 12 feet versus five to seven feet). Rotovators are basically underwater rototillers which churn the bottom sediments to a depth of up to 12 inches.

This action dislodges plants and root crowns. Typical rotovation will provide one to three years of acceptable weed control.

Dislodged plants must be collected as they float to the surface. As with plant cutting or harvesting, rotovation should not be considered in lake or river systems where plants are in the pioneering stages of an infestation and/or spread by fragmentation. Rotovation would not be expected to control non-rooted plants such as Coontail (*Ceratophyllum demersum*).

Advantages of Rotovation:

-removes entire plant including roots,
-longer effectiveness than with harvesting,
-plant density becomes reduced after successive treatments.

Disadvantages of Rotovation:

-does not collect plants or fragments which are uprooted,
-temporarily destroys bottom habitat and potentially fish spawning areas,
-causes turbidity and potential release of nutrients,

Costs of Rotovation:

-$1,000 to $2,000 per acre.

Appropriateness for Lake Wilderness:

-Rotovation is not considered appropriate for Lake Wilderness due to the lack of target specificity, the potential that this will significantly spread the problem through fragment generation and the difficulty in using this technique in rocky shoreline areas.

- **Diver directed suction removal**: Diver suction removal has been used since the 1970's as an improvement to hand removal of sparse colonies of Eurasian watermilfoil. The technique utilizes a small barge or boat carrying portable pumps with suction hoses that are directed by SCUBA divers. Divers dislodge the plant tissue and root system from the sediments and basically vacuum up the plant material which is carried back to the barge. On the barge, plant parts are sieved out and retained for land disposal while water and sediment materials are allowed to drop back into the lake.

Diver suction removal can be highly effective under the appropriate conditions. Efficiency of removal is dependent on sediment condition, plant size and density, and underwater visibility. It is best used for localized infestations of low plant density where fragmentation must be minimized. This technique is also selective in that divers can target a single species in a mixed population area.

An environmental concern with diver suction removal is that of turbidity and nutrient release from disturbed sediments. This is primarily applicable with light, organic sediments that often accumulate in heavy weed bed areas. However, the divers typically do not let the suction intake come near the sediments, rather they pull the target plants up out of the sediment and direct the plant into the suction intake. While sediment curtains can be used to minimize the drift of re-suspended sediment materials and also escaped plant fragments, there is no practical way of controlling nutrient release. Placement of sediment curtains is also time consuming and, thus, costly.

Advantages of Diver Suction Removal:

-species selective and site-specific control,
-minimal disruption of sediments and surrounding habitat with non-rooted plants,
-minimal release of plant fragments,
-no depth constraints, effective near obstacles,
-effective in covering large areas with light plant growth.

Disadvantages of Diver Suction Removal:

-labor intensive and expensive,
-may not be appropriate control method in dense plant beds,
-potential release of nutrients and sediments, potential short-term increased turbidity.
-may not work well in gravelly or rocky areas due to the difficulty in pulling up all root fragments

Costs of Diver Dredging:

-$1,000 to $2,000 a day for two divers and support boat,
-typical coverage from 0.25 to 1.0 acres per day.

Appropriateness for Lake Wilderness:

-Diver operated suction removal has some applicability at Lake Wilderness. However, due to the expected cost of this type of treatment it is considered only as a backup technique.

Biological Control Methods

Currently Available Techniques - Biological Control. The biological control of aquatic plant problems focuses on the selection of organisms that have an impact on the growth of a target plant. By stocking a lake with these organisms, or "agents", the population of the target plant can be reduced. Biological control is not an exact science at this time. There have been a number of dramatic success stories with the control of aquatic weeds using some organisms. There have also been some undesirable effects from their use. The majority of the tools in this field are in the experimental or review stage at this time.
Biological control agents are generally of two types. There are general agents like grass carp that will consume most aquatic vegetation. As such, they are of limited use when trying to target specific plants. The second type of "biocontrol" agent are those that are target-specific for problematic species. Many of these agents focus on exotic plants that have been introduced to this country. Research typically starts in the region of the world where these plants are from, and focuses on the organisms that keep it in check there. Once identified, these organisms are brought through a quarantine protocol into this country where further research is conducted to determine if there is operational potential for control. At this time there are no biological control agents available in Washington State which are effective against *M. spicatum* other than grass carp.

- **Grass Carp**: Grass carp (or White Amur) are plant consuming fish native to China and Siberia. There are a wide range of aquatic plants that these fish will eat, but they have definite feeding preferences and will generally eat the plants they prefer first. Stocking rates are dependent on climate, water temperature, type and extent of plant species and other site-specific conditions. The recommended maximum stocking rate in

Washington is 25 fish per acre (Bonar et al. 1996) and the typical stocking rate is nine fish per acre (Hamel 2002). A study of grass carp usage in Washington has indicated that in most cases grass carp either have little effect or will eat all submersed plants.

Periodic restocking is generally necessary to replace fish lost to predation or disease and to maintain the number of young, actively growing (and thus actively eating) fish. Only triploid (sterile) fish can be planted in Washington and by permit only. Grass carp must be imported by approved suppliers and be certified to be disease and Zebra mussel free and sterile. Inlets and outlet screens must be installed in the lake and be approved by WDFW biologists prior to stocking.

Water Quality is seen to generally improve after introduction of grass carp; with the elimination of large mats of vegetation, bottom dissolved oxygen levels generally increase from levels lethal to fish and pH generally decreases with decreases in photosynthesis (WDFW 1990). However, water turbidity increases have also been documented due to grass carp stirring up bottom sediments. Effectiveness of grass carp in controlling aquatic weeds depends on feeding preferences and metabolism which vary from region to region. Some plant species which appear to be preferred include pondweed species, Coontail and Elodea. Plant control effectiveness is site specific and significant control of vegetation may not be apparent until two to four years following introduction. While grass carp have been reported to also consume filamentous algae, their effect on planktonic algal forms is unknown.

Advantages of Grass Carp:

-non-toxic
-long-term effectiveness

Disadvantages of Grass Carp:

-may not control the Milfoil present in Lake Wilderness
-may alter composition of plant community without decreasing overall biomass,
-may decimate submersed aquatic plants and result in worst algae problems, and disruption of native fish habitat,
-inlet and outlet screens must be constructed and must allow passage of native salmonid fishes,
-carp foraging may cause turbidity and foster algal growth through re-suspension of sediment materials.

Costs of Grass Carp:

-$10.00 to $15.00 per fish (plus delivery),
-typical stocking rates are 9 to 15 fish per acre,
-inlet / outlet screen costs not determined.

Appropriateness for Lake Wilderness:

-Grass carp are not considered appropriate for use in Lake Wilderness due to their uncontrollable nature, lack of target specificity and, thus, potential adverse effects on the native plant populations in conservancy areas and fish habitat in the lake.

Host-specific pathogens (fungi, bacteria, virus)

There are no host-specific pathogens currently available and labeled (approved) for use in Washington State. As such, these tools are not appropriate for Lake Wilderness. This is one area of ongoing research that holds promise in aquatic plant management however. The LMD should endeavor to stay current on the advancement in this area and consider them for use if appropriate in the future.

Host-specific insects

There are no host-specific insects currently available and labeled (approved) for use in Washington State for the management of submerged native aquatic plants. While there are insects that have shown promise controlling Eurasian watermilfoil, these agents have not performed predicatively in the field. As such, these tools are not appropriate for Lake Wilderness. This is one area of ongoing research that holds promise in aquatic plant management however. The LMD should endeavor to stay current on the advancement in this area and consider them for use if appropriate in the future.

Genetic engineering technologies

There are no genetically engineered technologies currently available and labeled (approved) for use in Washington State. As such, these tools are not appropriate for Lake Wilderness. This is one area of ongoing research that holds promise in aquatic plant management however. The LMD should endeavor to stay current on the advancement in this area and consider them for use if appropriate in the future.

Chemical Control Methods

Currently Available Techniques - Chemical Control. Chemical herbicides are one of the leading methods of controlling, and in some cases, eliminating, noxious aquatic plant growth. The herbicides which are approved for aquatic use by the US EPA are well reviewed and considered compatible with the aquatic environment when used according to label directions. In addition to the review and regulation provided by the EPA, the Washington Department of Ecology completed an Environmental Impact Statement (EIS) in 1992 for the aquatic plant management program which allows for the introduction of a number of compounds into state waters. This EIS was recently updated by WDOE and information contained in the Supplemental EIS (WDOE 2001) as been used in the preparation of this IAVMP. Note that the application of chemicals for aquatic pest control can only be performed by a licensed pesticide applicator with an aquatics endorsement.

There are two general types of aquatic herbicides in use; referred to as “contact” and “systemic” products. Contact herbicides kill susceptible plant stems and leaves generally leaving roots and some reproductive structures alive and capable of regrowth. As such, a contact herbicide is generally considered a maintenance tool, one that can provide relief from aquatic plant problems, but not something that can eliminate the problem from the lake system. Systemic herbicides are absorbed and carried throughout the plants thereby making them capable of killing the entire plant.

The contact herbicides approved for use in Washington State are Endothall and Diquat. The four systemic herbicides which are registered and approved for use in Washington are Fluridone, 2,4-D, triclopyr and Glyphosate. Glyphosate is not appropriate for control of submersed plants and will not be discussed in this IAVMP.

- **Fluridone**: Fluridone is available in the SePRO Corporation products Sonar AS® (a liquid formulation), Sonar SRP® (a slow release pellet formulation) and Sonar PR® (a "precision release" pellet formulation). Fluridone is also available in the Griffin LLC liquid product Avast.

Fluridone can show good control of submersed and emergent plants, including Milfoil, where there is little water movement and an extended time for the treatment. It is most applicable to whole-lake or isolated bay treatments where dilution can be minimized. Because of the eight- to ten-week recommended treatment period, treatments should take place in early spring or fall.

Fluridone interferes with the synthesis of RNA, proteins and carotenoid pigments and thereby affects photosynthesis (WDOE 2001). Use of fluridone does not pose a threat to human health or to fish and wildlife when used according to the label (SePRO 2004). While there is a short term (seven to 30 days) precaution when using treated waters for irrigation, there are no other water use restrictions when using the liquid formulation of fluridone.

Advantages of Fluridone:

-systemic herbicide, will kill entire target plants,
-variety of plants are susceptible, based on treatment rates and program design,
-species specificity with correct application rates,
-non-toxic to humans, pets, fish and wildlife,
-no water use restrictions for fishing, swimming or livestock/pet consumption.

Disadvantages of Fluridone:

-Long exposure period required in order to effectively control plants (many times requiring multiple application or minimize flow conditions)
-Potential for drift from application area, requires whole lake or enclosed area treatments

Costs of Fluridone:

-$80,000.00 for Lake Wilderness whole lake treatment

Appropriateness for Lake Wilderness:

-Fluridone products are not considered appropriate for use in Lake Wilderness at this time due to the limited but spread out extent of the milfoil infestation (ie. the need for spot treatments).

- **Endothall**: Endothall is a contact herbicide available in the Cerexagri, Inc. products Aquathol K® (a liquid formulation), Aquathol Super K® (a granular formulation), and Hydrothol 191® (both liquid and granular formulations).

Endothall compounds are used primarily for short term (one season) control of a variety of aquatic plants (and algae in the case of Hydrothol 191®). The mode of action of Endothall is not fully understood although the hypotheses indicate that this chemical

disrupts biochemical processes at the cellular level (WDOE 2001). Target plants for Aquathol K® and Aquathol Super K® include Milfoil (Cerexagri 2004). Neither Coontail or Elodea is listed as a target for Hydrothol 191® (liquid or granular). Duration of control with Endothall products is dependent upon target species, contact efficiency, lake conditions and regrowth form unaffected root masses.

Use of Endothall involves several water use restrictions and it can be toxic to fish although there is a wide margin of safety between allowed application rates and rates that are toxic. At application rates needed to control Milfoil (2.0 to 4.0 ppm) the water use restrictions are: do not use fish from treated areas for food for three days and do not use water from treated areas for watering livestock, preparing agricultural sprays for food crops, for irrigation or for domestic purposes for seven to 14 days after application. There is no swimming restriction for Endothall products. Fish toxicity is not a factor, according to the product labels, at doses below 100 ppm (Cerexagri 2004).

Advantages of Endothall:

-fast acting injury to plant tissue which is typically apparent in one to two weeks,
-little or no off-target drift impacts,
-spot treatments possible,

Disadvantages of Endothall:

-only provides temporary reductions in plant growth,
-non-target plant impacts are difficult to mitigate as this is a fairly broad spectrum herbicide (Elodea is not listed as susceptible),
-water use restrictions in place,
-rapid action may cause oxygen depletion and rapid release of nutrients into water

Costs of Endothall:

-$650.00 per treated acre

Appropriateness for Lake Wilderness:

-Endothall products are not considered appropriate for use at Lake Wilderness due to the lack of systemic activity toward one target plant Eurasian watermilfoil and the lack of activity against the primary native plant target elodea.

- **Diquat**: Diquat dibromide is a fast acting, broad spectrum contact herbicide and algaecide found in the product Reward® which is manufactured by Syngenta (formerly Zeneca Ag Products, Inc). See Appendix B for web site links where label information can be found.

Diquat is effective on a variety of submersed plants, including Milfoil, and also some types of filamentous algae. Diquat's mode of action is to generate "reactive oxygen radicals" which disrupt photosynthesis. Diquat kills plants rapidly so depletion of oxygen and release of nutrients from plant decay is a potential problem. As with all contact herbicides, plant roots are not effected and repeated applications may be needed for complete season control.

Water use restrictions which would be in force with diquat applications for Milfoil control (two gallons Reward per surface acre) are three days for drinking, one day for livestock drinking, three days for irrigation to turf and ornamental and five days for irrigation to

food crops. There is no restriction for fishing or swimming in treated water (Syngenta, 2004).

Advantages of Diquat:

-effective against many plant species,
-rapid action,
-no bioaccumulation,
-no fishing or swimming restriction.

Disadvantages of Diquat:

-water use restrictions in place,
-repeat applications needed to maintain control
-rapid action may cause oxygen depletion and rapid release of nutrients into water

Costs of Diquat:

-$295.00 per acre for Reward®

Appropriateness for Lake Wilderness:

-Reward (diquat) is considered appropriate for use at Lake Wilderness.

- **2,4-D**: 2,4-D is a fast-acting systemic herbicide with two formulations approved for freshwater applications in Washington State. The two formulations are the butoxyethyl ester (BEE) formulation found in the granular products AquaKleen® (produced by Rhone Poulenc and marketed by CerexAgri) and Navigate® (marketed by Applied Biochemists); and the dimethylamine (DMA) formulation found in the liquid product DMA4® IVM, produced by Dow AgroSciences LLC. See Appendix B for web site links where label information can be found.

The mode of action of this chemical is primarily as a stimulant of plant elongation and cell division (WDOE 2001). 2,4-D is a post-emergent herbicide that is primarily used to control watermilfoil and water stargrass. Typical submersed monocot plants (ie. the pondweeds) are not susceptible to 2,4-D so this product can be used for selective plant control.

2,4-D can be effectively used in spot-treatment programs in lakes or ponds. Effectiveness of the treatment is dependent upon the timing of the application and density of the target plant community. Two treatments may be required when targeting dense communities. Susceptible plants will begin to show signs of injury one to two weeks after treatment, followed by plant breakdown and death.

There is no fishing or swimming restriction associated with the use of 2,4-D. The recent risk assessment prepared for WDOE as part of the 2001 Final Supplemental Environmental Impact Statement for the aquatic plant management program (WDOE 2001) indicated that “no significant adverse impacts on fish, free swimming invertebrates or benthic invertebrates” should be expected from 2,4-D (either formulation) applications at appropriate label rates. Additional toxicity information from this risk assessment is included in Appendix C following the Navigate and DMA4 labels.

Advantages of 2,4-D:

-fast-acting systemic herbicide which is effective in removing selected plants with little or no impact on certain non-target plants at labeled rates,

-applications conducted easily with granular or liquid material in a large or small scale applications,
-treated waters can be used for swimming within 24 hrs (WDOE restriction),
-no fish consumption restrictions.

Disadvantages of 2,4-D:

-application must be conducted 0.5 miles or greater from active drinking/domestic water withdrawals (unless approved by WDOE),
-24 hour swimming restriction imposed by WDOE,
-treatment windows apply to areas were Endangered Species Act (ESA) listed salmonids occupy (according to WDFW specifications).
-Monitoring is required to determine when lake levels drop below 70 ppb prior to use of lake water for irrigation.

Costs of 2.4-D:

-$600 per acre applied, target dose 1 ppm.

Appropriateness for Lake Wilderness:

-2,4-D (either of the listed formulations) is appropriate for use in Lake Wilderness due to the specificity for the target species (Milfoil), the rapid systemic action and dissipation of the herbicide, the demonstrated efficacy and the general acceptance of this chemical based on past uses. This is one preferred treatment method as described in the Integrated Treatment Action Plan.

- **Triclopyr**: This is a systemic herbicide produced by SePRO Corporation.

Triclopyr is a product that has been tested extensively and found to be effective on broad-leafed (dicotyledonous) plants such as Milfoil. This product is specific for this type of plant and can be used in habitat recovery programs focusing on selective removal of these plants. It will not affect plant species in the monocot family, which is the majority of native aquatic and wetland plant types. Renovate® is a liquid product with a contact time requirement of 24 to 48 hours so it has applicability in spot treatments. Susceptible submersed plants exhibit epanasty (bending and twisting of plant tissue) in 6 - 12 hours after treatment. Treated plants begin to sink slowly three to five days after treatment and one to three weeks later plants should be well below the surface, often near the bottom.

Photodegradation is the major route of triclopyr degradation in aquatic environments. The first order half-life for Renovate® is 0.5 - 3.0 days. No accumulation occurs on sediment and no bioconcentration is believed to occur in sport fish or bottom feeding species. Toxicity testing on fish and other non-target organisms performed by or for the manufacturer has indicated that Renovate® has a low toxicity potential (SePRO Corporation 2002).

Advantages of Triclopyr:

-selective for broad leafed plants,
-short contact time needed,
-systemic action so entire plant is killed.

Disadvantages of Triclopyr:

-only effective against Eurasian Milfoil

Costs of Triclopyr:

-ranges from $600.00-1,000.00 per acre depending on water volume.

Appropriateness for Lake Wilderness:

-Renovate® (triclopyr) is appropriate for use in Lake Wilderness.
-

Vegetable dyes.

These dyes are designed to absorb light in the same parts of the spectrum aquatic plants need to photosynthesize. This limits the penetration of light in the water column and prevents the growth of submerged aquatic plants in deeper water. Another way to view this is artificially limiting the littoral zone to the shallow margins of the lake. The environmental impact of this tool would be to reduce the number of acres in Lake Wilderness that support aquatic vegetation. This technology is not considered appropriate for Lake Wilderness because it would control vegetation in both the high use and conservancy areas of the lake.

New Technologies

There are new technologies being developed in the aquatic plant management field on a regular basis. All of the technologies that are currently operational were considered in the process of updating this IAVMP. The LMD should endeavor to stay current on the advancement in this area and consider them for use if appropriate in the future.

Appendix B
Herbicide Label Information

The Lake Wilderness Community has selected aquatic herbicides as one of the key tools necessary to control noxious and nuisance aquatic vegetation. Aquatic herbicide labels are very lengthy and presenting the entire label here would necessitate the inclusion of an additional 40-50 pages in this document. These labels do include good information that may be of interest to the users of this document. Information links where these labels can be accessed are presented here for the herbicides that are considered appropriate for use at Lake Wilderness.

Cerexagri is the manufacturer of two aquatic herbicide formulations that may have applications at Lake Wilderness in the coming years.

AquaKleen is a granular 2,4-D product that is effective against infestations of Eurasian Milfoil. The information link for this product is http://www.cerexagri.com/aquatic/aquakleen.asp. This site contains general information on this product and links to the product label and MSDS sheets.

Aquathol K and Aquathol Super K Granular are herbicides that may have applications at the lake in the future. Both forms of this herbicide are manufactured by Cerexagri. The information link for these products is http://www.cerexagri.com/aquatic/aquathol.asp. This site contains general information on these products and links to the product label and MSDS sheets.

Dow Agrosciences is the manufacturer of Dow DMA 4IVM. This product is a liquid formulation of 2,4-D and is effective against infestations of Eurasian Milfoil. The Dow Agrosciences web site allows the user to download labels from the following site: http://www.cdms.net/manuf/mprod.asp?mp=11&lc=0&ms=3691&manuf=11.

SePRO Corporation manufactures a number of aquatic herbicides that may be used on Lake Wilderness in the future. They are the manufacturer of Sonar Aquatic Herbicides. These products have been used successfully in Lake Wilderness in the past to control Eurasian Milfoil. Sonar is a fluridone based herbicides. SePRO recently acquired the rights to the generic formulation of this herbicide, AVAST. SePRO also manufactures Renovate, a systemic herbicide that is effective against Eurasian Milfoil. Information on these products can be accessed at the following link: http://www.sepro.com/default.php?page=aglist.

Syngenta Professional Products is the manufacture of Reward Aquatic Herbicide. This herbicide is recommended in this plan when nuisance aquatic vegetation expands to the point of interfering with beneficial uses of the lake. The label for this product can be accessed at http://www.syngentaprofessionalproducts.com/labels/Index.asp?nav=PrdLst&F=PrdDsp.

Appendix C
Meeting Attendance, Public Input

Citizens Advisory Committee
Lake Wilderness Management District
Meeting, January 14, 2004

Sign In Sheet

Bob White
Salley Abella
David Barber
Don Harig
Mary E. Anderson
Adam Klera
Patrick G. Anderson
Patrick O Anserson
Ray Petit
Roger King
Kyle Langan
Terry McNabb
Cindy Krebs

During this meeting, Aquatechnex made a presentation of the required elements of the Integrated Aquatic Vegetation Management Plan (IAVMP). A checklist of DOE requirements was developed that compared the information in the 1997 plan to the current necessary information. This checklist will be used to update this document.

The committee then was presented with the Problem Statement from the original document. Discussion focused on whether this statement needed to be brought current. The statement was amended to reflect current conditions and opinions of the committee.
A beneficial use map needs to be created for the IAVMP. A map of the lake was displayed and the committee discussion helped develop beneficial use zones. These were recorded and used to develop the current beneficial use map.

Aquatechnex staff presented current information on aquatic plant management strategies that might be applicable for Lake Wilderness. Discussion then focused on narrowing the tools available to the specific needs of the community. Recommended control strategies were developed for presentation to the community

Citizens Advisory Committee
Lake Wilderness Management District
Meeting, February 3, 2004

Sign In Sheet

Lisa McKenney
Salley Abella
Jeff McKenney
Patrick G. Anderson
Bridget A. Anderson
Patrick O. Anderson
Patrick W. Anderson
Colby Collier
Patrice Roney
Trevor Roney
Andy Gillespie
Robert Ludke
Diana Ludke
Linda McMOnagle
Barbara Petit
Susan Tangen
Rachel Petit
Thomas Petit
Diana Konno
Craig Konno
Ed Denn
Nadene Thiesen
Betsy Bradsby
Don Cooper
Jo Ann Cooper
John Vasboe
Roger King
Kathy Eades
Alan Eades
Joe Cluett
Jordon Cluett
Jessica Cluett
Ryan Cluett

Terry McNabb
Kyle Langan
Adam Kleven

The purpose of this meeting was to present the work of the CAC to the members of the Community surrounding the lake.

The City of Maple Valley contacted local media outlets to publicize the meeting time and location. A substantial number of the residents around the lake attended this meeting.
Aquatechnex made a presentation of the IAVMP process, the work that had been done to date by the committee, the selected course of action and invited comments and discussion from the group.

Maps of aquatic vegetation in the lake and the beneficial use maps were presented to the group. There was discussion and comments offered regarding the high use areas on the benefical use map. Residents on the southeast shoreline wanted to insure that they were included in areas that might receive control if warranted during operations on the lake.

The group was presented with the preferred control options published in this document and asked to adopt those recommendations. After some discussion, the group approved the preferred options published in this IAVMP for the future.

Citizens Advisory Committee
Lake Wilderness Management District
Meeting, March 25, 2004

Sign In Sheet

Diana Pistoll
Salley Abella
David Barber
Stephen Gleaves
Andy Gillespie
Bill Cuenzler
Betsy Bradsby
Patrick G. Anderson
Colby Collier
Ray Petit
Roger King
Kyle Hansan
Terry McNabb

The purpose of this meeting was to review the progress in the development of this IAVMP, to provide one additional opportunity for members of the public to comment or provide input with respect to the development of this plan and to meet Ecology requirements for public opportunity to provide input.

This meeting was publisized by City of Maple Valley in the local media. Aquatechnex staff presented an overview of the work performed in the development of this plan to date, the preferred options that were selected by the CAC and the public at the previous meeting and invited comment or discussion. Discussion was limited as most of those in attendance had been present and involved in the previous public opportunities.

The attendees were asked to approve the work of the Committee with respect to the preferred control options in the draft IAVMP. The document was approved.